Essays on the Impact of Foreign Direct Investments in Africa

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ESSAIS SUR L'IMPACT DES INVESTISSEMENTS DIRECTS ÉTRANGERS EN AFRIQUE

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Le CERDI n’entend donner aucune approbation ou improbation aux opinions émises dans cette thèse. Ces opinions doivent être considérées comme propres à leur auteur.

À mon épouse, Divine Promesse

&

à nos enfants,

Stacey Thaliane, Lindsay Emmanuella et Andy Loris.

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Résumé / Abstract

Résumé

Cette thèse a pour objet d'analyser l'impact des flux d'investissement direct étranger (IDE) reçu par l'Afrique sur la croissance économique, l'industrialisation et le transfert de technologie. Les analyses portant sur la croissance économique et l'industrialisation sont basées sur des données macroéconomiques comprenant respectivement 50 et 49 pays africains observés sur la période 1980-2009 ; et les analyses portant sur l'impact des flux d'IDE sont basés une étude de cas mobilisant des données microéconomiques des firmes kenyanes du secteur manufacturier observées en 2012/2013. Les résultats des analyses de l'impact des IDE sur la croissance économique suggèrent que : les flux d'IDE ont eu impact positif et significatif sur la période 1980-2009 ; mais que cet impact a probablement été non significatif ou négatif pendant la période 1980-1994 alors que l'impact a été significativement positif sur la période 1995-2009. En outre, le relatif faible niveau des capacités d'absorption n'a pas contraint l'impact positif sur la croissance économique. S'agissant de l'industrialisation, les analyses suggèrent que l'impact des IDE sur le secteur manufacturier n'a pas été significativement différent de zéro pendant la période d'étude. Concernant l'existence de transferts de technologie horizontaux au Kenya, les analyses révèlent une absence de significativité de l'impact des IDE sur le degré d'innovation des firmes locales en concurrence avec les firmes internationales.

Mots clés: investissement direct étranger (IDE), Afrique, croissance économique, industrialisation, transfert de technologie, données de panel, Kenya, impact.

Abstract

The objective of this thesis is to analyze the impact of foreign direct investment (FDI) inflows towards Africa on economic growth, industrialization, and technological transfer. Analyses aiming at studying the nexuses FDI-economic growth and FDI-industrialization are based on macroeconomic data from respectively 50 and 49 African countries observed during the period from 1980 to 2009; and analyses on FDI related technological spillovers are based on Kenyan firm-level data observed in the manufacturing sector during the period 2012/2013. Concerning the FDI-economic growth nexus, it is found that FDI inflows had a significant impact on economic growth in the African region during the period of interest. It also finds that while the low level of human resources did not limit the impact of FDI, and that the impact of FDI on economic growth was negative or non-significant during the period from 1980 to 1994 and positive during the period from 1995 to 2009. The results indicate that FDI most likely did not have a significant impact on the industrialization of African countries. Concerning the existence of FDI-related technological transfer, it is found that FDI inflows did not spur innovation in local firms competing against multinational firms.

Keywords: foreign direct investment (FDI), Africa, economic growth, industrialization, technological transfer, panel data, Kenya, impact.

General Introduction

General Introduction

Background

Two major global events marked the year 2015: the United Nations Summit on the Post-2015 Development Agenda held in New York in September 2015 and the third Conference on Financing for Development (FfD) held in Addis Ababa in July 2015. The conclusions of the UN Summit have been translated into 17 sustainable development goals (SDGs) that are expected to be achieved by 2030, whereas the conclusions of the Conference on FfD are encompassed in the Addis Ababa Action Agenda (AAAA).[1] These two outcomes provide a global framework for goals to be achieved for SDGs and policy guidelines on the means to be used to finance their achievements, respectively.

In general, the first point that could be made from an economic perspective would be the following: achieving these 17 goals would require maintaining and sustaining the economic expansion of the economies and even rethinking the underlying economic strategies. This condition is necessary but not sufficient because new constraints will have to be considered. In fact, these goals encompass economic, social and environmental objectives and targets, and the task ahead of African countries would be huge because they did not achieve most of the millennium development goals (MDGs), even though some progress was recorded (United Nations, 2015b; UNECA *et al.*, 2014).

[1] See United Nations (2014) and United Nations (2015a) for details on the proposed list of sustainable development goals and the conclusions of the third conference on financing for development, respectively.

In fact, even though there was a debate on the assessment of countries' achievements in connection with MDGs, UNECA *et al*. (2014) note that African countries' achievements are considered as being "off-track" for most MDG targets. Although initial conditions, as presented by UNECA *et al.* (2014), played an important role in this poor performance, one of the underlying reasons for these results can also be dated back to UNECA (2010), who analyze economic growth drivers, total factor productivity and the employment intensity of growth. According to UNECA (2010), growth output originated mainly from the natural-resource sector, which is capital intensive, linkages between the natural resource sector and the non-resource sector are weak, and recorded economic growth rates were below the 7% target required for the achievement of MDGs. As a result, the employment intensity of growth was low, and the expansion of the economies could not contribute to jobs creation and thus to the achievement of poverty-related goals and targets. Several institutions, entities and economists thus agree on the need to change the economic strategies underlying the expansion of African countries. The SDGs number eight and nine – *No. 8: Promote sustained, inclusive and sustainable economic growth, full productive employment and decent work for all; No. 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation* – emphasize this need and raise the question of finding appropriate financing instruments.[2]

[2] For instance, UNECA (2013) and the African Union Commission (2015) call for an industrialization of African countries. Conversely, Rodrik (2014) proposes agricultural-led growth or services-led growth because it would not be possible for African countries to follow earlier industrialization-based miracles observed in developed economies or some East Asian countries.

For the objective of financing this development agenda, member States agreed on actions and means to move this agenda forward. As such, several actions areas have been identified, including "*domestic and international private business and finance*" (United Nations, 2015a, p. 12). I would like to focus particularly on this action area because I value the role of the private sector in achieving economic development. In this action area, member States stress the role of the private sector as a major driver of inclusive economic growth, productivity and job creation, and foreign direct investment (FDI) inflows are encouraged as well as government policies aiming at strengthening positive FDI-related spillovers.

Although I acknowledge that the development of the private sector, in general, is crucial to achieve SDGs, the actual dissertation focuses only on the role of FDI inflows because this category of capital flows can help to achieve several development goals or targets, and Africa still has several investment opportunities for foreign companies. IMF (2009, p. 100) defines FDI as "*a category of cross-border investment associated with a resident in one economy having control or a significant degree of influence on the management of an enterprise that is resident in another economy*"; and the degree of influence is set at a minimum of 10% of the capital. Optimizing the policy mix implemented by countries would be essential because there has been a shift from an international agreement with eight goals to an agreement with 17 goals and more than 100 targets.

Concerning Africa's potential, African countries have several opportunities because "*Future world growth will depend on harnessing Africa's unique features, especially its untapped huge natural resources, youthful population and growing middle class*" (UNECA, 2012, p. 4), providing that African governments implement the appropriate

policies. Moreover, Africa has been receiving a growing amount of FDI inflows over the last decades. For instance, FDI inflows received by Africa reached $56 billion in 2009, approximately a six-fold increase since 2000 and 140-fold since 1980, and more could be received in the forthcoming years. In fact, for instance, China is going through a transformation that is related to the forthcoming upgrading of the Chinese manufacturing sector from "low skilled manufacturing jobs" to "leading dragon" (Lin, 2012), its internal reforms, and the growing demand for better wages from the labor force. Lin (2012) argues that this future transformation could thus be an opportunity for other developing countries.[3]

Furthermore, theoretical frameworks and existing empirical analyses can also provide the elements of a potential positive impact of FDI inflows on economic growth, industrialization, and innovation and an indirect impact on jobs creation, poverty, productivity and economic transformation as key elements of the SDGs framework.

Theoretical Considerations on the Impact of FDI Inflows & the Research Questions

Concerning economic growth, reference can be made to the Solow model and the endogenous growth theory, which provide a theoretical basis for understanding the role of technological change and factors of production such as labor and physical capital in the expansion of economies (Solow, 1956; Romer, 1986; Mankiw, Romer, & Weil, 1992). Although Solow (1956) and Romer (1986) stress the role of technological change as an economic growth driver, they have different views on the fact that technological change is exogenous for Solow (1956) and endogenous for Romer (1986).

[3] See Dollar (2014) for other elements on Chinese rebalancing.

Romer (1986) assumes that technological change is the result of research and development activities, thus requiring a stock of knowledge. Mankiw, Romer & Weil (1992) confirm Solow's approach but stress the role of human capital in the production process.

FDI inflows can fit in this model because they are capital flows that lead to the acquisition of physical capital, and multinational enterprises hold specific advantages when they decide to operate abroad: the knowledge element. For instance, among all of the theoretical frameworks used to explained the choice of multinational enterprises, the O.L.I. paradigm mentions that the choice of multinational enterprises regarding the location of their investments is related to the fact that they have a specific advantage (Ownership advantage), there is an advantage to install their firm in the selected area (Location advantage), and the firm has a specific internal advantage (Internalization advantage) (Mucchielli & Mayer, 2005, p. 259). The ownership and internationalization advantages would mean that multinational companies bring additional knowledge and that they can contribute to an improvement of the productivity at the firm, industrial and national levels if specific conditions are fulfilled.

Among determinant factors of FDI positive spillovers, Borensztein, De Gregorio, & Lee (1998) find that the size of the impact of FDI inflows on the host economies depends on their absorptive capacities, Crespo & Fontoura (2007) highlight other factors such as regional effects, domestic firms characteristics, FDI characteristics, trade policy, and intellectual property rights, and Alfaro *et al.* (2010) stress the role of the development of the host country financial market.

In consequence, because FDI inflows are part of the financing strategy of SDGs and their importance for economic growth has been highlighted, it could be legitimate to

question their role during the last decades. Answering this question could help in formulating appropriate policies and could help in identifying or stressing past and current issues.

Research question No. 1: What has been the impact of FDI inflows on economic growth in Africa? Did absorptive capacities matter?

Analyzing the role of FDI inflows in the expansion of African economies thus constitutes my first research question. I will now turn to the issue of economic transformation through industrialization.

Pertaining to industrialization, two major models identify the role of FDI inflows in the industrialization process: the model developed by Markusen & Venables (1999) and the model developed by Rodríguez-Clare (1996). The model developed by Markusen and Venables (1999) analyzes this impact in terms of the number of enterprises and can be used to analyze the impact on industrialization defined in terms of GDP or value added, whereas the second model can be used for the employment-oriented definition of industrialization. Markusen and Venables (1999) suggest that two effects can emerge from the entry of MNCs: a competition effect and a linkage effect. The former can stimulate local firms to perform research and development to increase their probability of survival, whereas the latter can be beneficial to local firms through training and direct technological transfer aimed at increasing standards of production for local suppliers or through the usage of advanced inputs by local clients. Rodríguez-Clare's (1996) results concur with those of Markusen & Venables (1999) on the necessity for the enterprise to intensively use local inputs for the objective of creating more local jobs, thus increasing

forward and backward linkages. Thus, if local firms are not ready to take advantage of the presence of MNEs or if the competition is too high, it is possible that the net impact of FDI inflows could also be negative. By analyzing these findings in conjunction with the low level of development of the manufacturing sector in Africa or the "de-industrialization" of Africa (UNECA, 2013), a question on the role FDI inflows in this process can be raised. Attempting to analyze this question will constitute the second research question of this dissertation.

Research question No. 2: What has been the impact of FDI inflows on the industrialization or de-industrialization of African countries?

After attempting to understand the role of FDI inflows in the expansion and the transformation of African economies, one can question the role of technological transfer in African countries because all of the above mentioned theoretical models assume, explicitly or implicitly, that FDI inflows can contribute to technological transfer. Three contributions to the theoretical explanation of technological transfer can be mentioned: Bertschek (1995), Vishwasrao & Bosshardt (2001) and Guadalupe, Kuzmina, & Thomas (2012). Bertschek (1995) explains process and product innovation by imports and FDI in a domestic market characterized by monopolistic competition and finds that an increasing presence of foreign firms could increase both types of innovation through a decrease in prices. Vishwasrao & Bosshardt (2001) analyze the adoption of innovations introduced by foreign firms and find that foreign-owned firms are more likely to adopt technologies because they have lower initial costs of adoption and lower capital costs compared with domestic firms. Guadalupe, Kuzmina, & Thomas (2012)

analyze the impact of foreign ownership on innovation and find that the initial productivity of the foreign invested enterprises is an important determinant of this impact. Thus, one way to analyze the role of FDI inflows in the host economy can be through an analysis of the occurrence of technological transfer. The third research question of this dissertation is as follows:

Research question No. 3: Did FDI inflows contribute to technological transfer in Africa or at least in one non-commodity dependent country?

Although answering the above-mentioned questions could be helpful for decision making, it has to be acknowledged that few studies have been performed in the case of African countries, and I intend to take stock of the existing studies.

Overview of Existing Studies and the Contribution of the Proposed Analyses

Concerning studies analyzing FDI and economic growth in Africa, there is a limited number of them, among which the following can be cited as recent studies: Akinlo (2004), Fedderke & Romm (2006), Adams (2009), Agbloyor *et al.* (2014), Adams & Opoku (2015) and Seyoum, Wu, & Lin (2015). Studies performed by Akinlo (2004) and Fedderke & Romm (2006) focus only on Nigeria during the period from 1970 to 2001 and on South Africa from 1956 to 2001, respectively. Analyses performed by Akinlo (2004) and Fedderke & Romm (2006) involve co-integration analyses. Adams (2009), Agbloyor *et al.* (2014), Adams & Opoku (2015) and Seyoum, Wu, & Lin (2015) focus on subsets of African countries and use other types of estimation methods such as

instrumental variables methods or vector auto-regressive models. On the basis of ordinary least squares estimators and fixed effect models applied to a dataset composed of 42 Sub-Saharan African countries observed during the period from 1990 to 2003, Adams (2009) concludes that FDI does not have an impact on economic growth. Adams & Opoku (2015), on the basis of generalized method of moments (GMM) estimators applied to a dataset of 22 sub-Saharan countries observed during the period from 1980 to 2011, conclude that FDI does not have an independent impact on economic growth, but only in conjunction with an improvement of different regulations. Agbloyor *et al.* (2014) find a negative impact of FDI inflows on economic growth in the case of 14 African countries on the basis of GMM estimators. These authors explain this result by the sector of investment of FDI, the crowding-out effect of FDI on domestic investment and the absence of a strong financial market. Finally, Seyoum, Wu, & Lin (2015) analyze the relationship between FDI and economic growth in Africa by using the Granger causality test.

I identify the following elements as some shortcomings of the above-mentioned studies: the coverage, time frame and estimation method in some cases. The study of Adams (2009) has a significant coverage of African countries, but the results can be weakened by the estimation method because endogeneity issues are not addressed properly with OLS and fixed effect models, even with the introduction of additional variables, as was done by the author. The studies performed by Adams & Opoku (2015) and Agbloyor *et al.* (2014) present an issue of geographical coverage and number of observations (below 200 for both of them), and both studies do not integrate human capital in their estimations, although this factor contributes to the efficiency of the labor force. The contribution of this dissertation would thus be to increase the coverage of the study of

the FDI-growth nexus to at least 50 countries, add human capital variables, and address issues related to the endogeneity of different variables through the usage of appropriate estimation methods such as instrumental variables and GMM.

Pertaining to the role of FDI in industrialization and technological transfer in Africa, to our knowledge, studies in these areas of research are scarcer and mostly focus on country cases.[4] Among the studies analyzing technological transfer or technological upgrading in a group of African countries, I can mention the contributions of Elu & Price (2010), Amighini & Sanfilippo (2014), and Farole & Winkler (2014), whereas Bwalya (2006) and Waldkirch & Ofosu (2010) perform studies in this area of research in the cases of Zambia and Ghana, respectively. Elu & Price (2010) conclude that Chinese FDI inflows do not have a significant impact on total factor productivity of firms observed in five Sub-Saharan African countries from 1992 to 2004, whereas Amighini & Sanfilippo (2014), on the basis of data from 2003 to 2010, find that South-South FDI inflows can foster diversification in low-tech industries and could contribute to an improvement of the quality of manufactured products sold on international markets. Farole & Winkler (2014) perform a study that attempts to assess technological transfer on the basis of 25,000 firm-level African observations (in the manufacturing sector) and conclude that the overall impact of FDI on productivity is negative but that an improvement of absorptive capacities can be beneficial to local firms (Farole & Winkler, 2014, p. 78). Farole & Winkler's (2014) results are similar to the ones found in Ghana and Zambia by Waldkirch & Ofosu (2010) and Bwalya (2006), respectively.

[4] I only highlight studies that analyze the role of FDI in technological upgrading because the latter can contribute to industrialization, and to our knowledge, there are a limited number of specific studies aiming at analyzing industrialization in Africa. More details on this indirect effect of FDI on industrialization are provided in Chapter 2.

From the above overview of the empirical literature on the impact of FDI inflows on technological transfer, and indirectly on productivity, I can identify the following as areas for further research: *(i)* few studies cover several African countries; *(ii)* the time frame of most studies is relatively short; *(iii)* it is possible to test the impact of FDI inflows on technological transfer on the basis of a variable that is different from an estimated productivity such as the occurrence of an innovation; *(iv)* the impact of FDI on industrialization is not directly assessed; and *(v)* the dataset composed of heterogeneous firms from different countries, which is used by Farole & Winkler (2014), may have a high degree of heterogeneity and thus may increase the estimation bias.[5] The contribution of this essay would thus be an analysis of the impact of FDI inflows on industrialization at the macro-economic level for a wide range of African countries in the period from 1980 to 2009 and a country analysis aimed at verifying the results obtained by Farole & Winkler (2014) on the role of FDI in technological transfer. The proposed analyses will be based on another dependent variable - the occurrence of innovation – because the measurement of productivity requires having a sample of firms that have been observed over a long period, and it is not possible to have access to such type of data in several African countries.[6] The proposed analyses also intensively use the approach implemented by Aitken & Harrison (1999) in the estimation of FDI spillover effects.

Outline of the Dissertation

The remaining of the thesis is organized in three substantive chapters, which are followed by a general conclusion.

[5] The authors try to overcome this issue by including different country-specific variables.

[6] The reader can refer to Olley & Pakes (1996) and Levinsohn & Petrin (2003) for more details.

Chapter 1 focuses on the impact of FDI inflows on economic growth in Africa. Two categories of analyses are performed, and two datasets are used. In terms of categories of analyses, dynamic and non-dynamic panel data equations are estimated. Both types of equations are estimated on the basis of a panel dataset composed of yearly data, and the dynamic panel data equation is also estimated on the basis of a five-year average dataset that accounts for purchasing power parities (PPPs) issues. In the yearly dataset, the dependent variable is the growth rate of the real gross domestic product (GDP), and in the five-year average dataset, the dependent variable is the GDP per capita (at constant 2005, PPP). In general, the panel datasets are composed of 50 African countries observed during the period from 1980 to 2009. Instrumental variables estimators and the system generalized method of moment (SYS-GMM) estimators, as proposed by Blundell and Bond (1998), are used, respectively, for the yearly and five-year average datasets. For both datasets, it is found that FDI inflows had a significant impact on economic growth in the African region during the period of interest. It also finds that the low level of human resources did not limit the impact of FDI. Analyses, performed on the basis of the five-year average dataset and by sub-period, show that the impact of FDI on economic growth was negative during the period from 1980 to 1994 and positive during the period from 1995 to 2009. For the yearly dataset, the impact is not significant during the period from 1980 to 2009 and is positive during the second sub-period.

After analyzing the impact of FDI on the expansion of African economies, I attempt to analyze the role of these flows in structural changes. **Chapter 2** thus examines the relationship between inward foreign direct investment (FDI) and the industrialization process in Africa using panel data from 49 countries over the period of 1980 to 2009.

The feasible generalized least squares (FGLS) method is used to perform the analyses, whereas sub-period analyses are performed as in **Chapter 1**. The results indicate that FDI did not have a significant impact on the industrialization of these countries, but other variables, such as the size of the market, the financial sector, and international trade, were important. This study concludes that the role of FDI in the transformation agenda, which is currently being discussed in Africa, should be carefully analyzed to maximize the impact of these capital inflows.

Chapter 3 attempts to analyze the impact of foreign direct investment inflows on technological transfer in Kenya. I focus particularly on Kenya because its manufacturing sector accounts for more than 10% of the GDP, it exports manufactured products in several neighboring countries, and its economy is relatively diversified compared to other African economies. It uses firm-level data compiled by the World Bank Enterprise Surveys unit. This firm data corresponds to the 2013 Enterprise Surveys organized in this country. The occurrence of product and process innovation is analyzed as a dependent variable because of methodological and data availability constraints. Technological transfer is measured at the industry level, and a two-step approach is implemented to account for selection. Robustness analyses are performed by sub-sample. On the basis of probit regressions, it is found that foreign investments did not spur technological transfer in Kenya.

Finally, I conclude and propose some policy recommendations (**General Conclusion**).

Chapter 1: Impact of Foreign Direct Investment on Economic Growth in Africa[7]

[7] Some sections of this chapter have been published as: **Gui-Diby S. L. (2014), Impact of foreign direct Investments on economic growth in Africa: Evidence from three Decades of panel data Analyses, *Research in Economics*, 68 (3), pp. 248-256.**

1. Introduction

Several studies have analyzed the impact of foreign direct investment (FDI) inflows on economic growth rates of different sets of countries over time. On one hand, it is assumed that FDI flows would have spillover effects on the host countries, such as enhancing job creation, capital accumulation, and knowledge transfer. In this regard, Crespo and Fontoura (2007) summarized five main channels of technological diffusion linked to FDI flows: demonstration or imitation, labor mobility, exportation, competition, and backward and forward linkages with domestic firms. These five channels, according to Crespo and Fontoura (2007), match, respectively, the following situations: (i) the efforts of domestic firms to adopt successful technology used by multinational enterprises (MNEs); (ii) the recruitment by domestic firms of workers with MNE experience who are able to use different technologies; (iii) the access to large distribution networks and the related gain due to a better knowledge of consumer tastes in foreign markets; (iv) a more efficient use of existing resources and technology, or the incorporation for domestic firms of new technologies in the production process to compete with MNEs; and (v) the relationships between MNEs and domestic firms, where the latter can be suppliers of MNEs (backward linkages) or customers of intermediate outputs of MNEs (forward linkages). On the other hand, according to new theories of economic growth and endogenous economic growth theories/models, the main determinants of economic growth, as summarized by Guellec and Ralle (2003), include investment in physical capital, technology, human capital, and public capital. The potential link between FDI and economic growth can, therefore, be established through human capital and technologies.

The majority of studies have focused on developing countries without, however, a particular emphasis on Africa. A particular focus on African countries may be interesting because FDI inflows to countries in this region have been increasing steadily over the past three decades. However, the impact of FDI on economic growth can be limited by the absence of absorptive capacities (Borensztein, De Gregorio, and Lee, 1998), and it seems that, due to their deficiencies in adequate human resources, African countries did not have the best conditions to benefit from spillover effects. Furthermore, according to the ranking of African countries in several issues of the *Doing Business Report*, it seems that sufficient efforts have not been deployed by policy makers to attract foreign investors and create attractive business environments. Therefore, analyzing the impact of FDI inflows may reinforce the importance of establishing sound economic policies aiming at attracting more FDI to unleash the economic potential of African countries.

With respect to the need for this study, two specific facts can be highlighted regarding FDI and economic growth. First, FDI inflows towards Africa rose from an average of 41 million USD for the period from 1980 to 1985 to 1,064 million USD for the period from 2005 to 2009 (in nominal terms), which represents an average growth rate of 99% for the overall period. Second, the average economic growth rate of the region changed from -0.41% during the period from 1980 to 1985 to 3.28% during the period from 2005 to 2009. In this regard, this chapter intends to fill the gap regarding FDI inflows towards Africa and present a better understanding of the inflows in relation to economic growth and absorptive capacities.

Concerning studies analyzing FDI and economic growth in Africa, there is a limited number of them among which the following can be cited as recent studies: Akinlo

(2004), Fedderke & Romm (2006), Adams (2009), Agbloyor et *al.* (2014), Adams & Opoku (2015) and Seyoum, Wu, & Lin (2015). Studies performed by Akinlo (2004) and Fedderke & Romm (2006) focus only and respectively on Nigeria and South Africa during the period from 1970 to 2001 and the one from 1956 to 2001. Analyses performed by Akinlo (2004) and Fedderke & Romm (2006) involve co-integration analyses. Adams (2009), Agbloyor et *al.* (2014), Adams & Opoku (2015) and Seyoum, Wu, & Lin (2015) focus on subsets of African countries and use other types of estimation methods such as instrumental variables methods or vector auto-regressive models.

I identify the following elements as some shortcomings of the above mentioned studies: the coverage, the time frame and the estimation method in some cases. Accordingly, the chapter assesses the impact of FDI inflows on economic growth in the African region during the period from 1980 to 2009. The contribution of the chapter could thus be related to the geographical coverage, the time span, and the dependent variable being used. Two datasets are used to check the robustness of the results.

The chapter is organized as follows: Section 2 presents a brief review of relevant studies in this area, Section 3 outlines the model specification, Section 4 highlights the data used for modeling and some methodological aspects related to the estimations, Section 5 presents the empirical results and their interpretation, and Section 6 summarizes the results from the study and presents conclusions.

2. Review of the literature

Two sets of broad approaches are described in the literature with respect to FDI and economic growth. The approaches in the first set are based on specific methods used for panel data, while the approaches in the second set use cross-section data with methods such as ordinary least squares (OLS), seemingly unrelated regressions (SUR) and cointegration, including country-by-country analysis. Within these sets of methods, the impact of FDI on economic growth is analyzed, with and without conditions or constraints.[8]

2.1. Results based on GMM, random and fixed effects models

In a complementary analysis that used results from a cointegration analysis in selected countries and from fixed effects models, De Mello (1999) concluded that the extent to which FDI has a positive impact on economic growth depends on the degree of complementarity and substitution between FDI and domestic investment. He also found that it is important to consider the heterogeneity of countries in the analysis as some results could change. The specificity of the approach is that control variables of economic growth are not used in the assessment of the impact of FDI on economic growth. Accordingly, this is a direct approach that has not been commonly used.

[8] The reader can also refer to De Mello (1997) for a selective survey of the related literature.

Using a panel of 85 countries, Azman-Saini, Baharumshah, and Law (2010) concluded that FDI, by itself, does not have positive effects on economic growth. Rather, the positive effects of FDI are observed if economic freedom is taken into account, specifically market regulation. In their analysis, they used GMM panel estimators, which were applied to panel dynamic models. In the estimated equation, they used FDI, economic freedom indicators and control variables to explain economic growth.

Based on a panel of 57 developing countries over the period from 1980 to 1999, Yabi (2010) concluded that FDI flows do not always have an impact on economic growth. He found that, due to the heterogeneity of countries, the positive impact of FDI was observed in countries with high economic growth but not in countries with low economic growth. These results were based on estimations with instrumental variables that included control variables that explained economic growth, such as local investment, years of secondary schooling of the male population, inflation, fertility rate, government consumption, rule of law, the number of telephone lines per thousands of people, etc.

2.2. Results based on OLS, SUR and cointegration

Blomsrtöm, Lipsey, and Zejan (1992), on the basis of ordinary least squares (OLS) estimations with data for the period from 1960 to 1985, found that FDI contributed positively to economic growth in higher income developing countries but not in lower income countries. The results are based on an equation that incorporates the following

variables in addition to FDI: the average ratio of the number of students enrolled in secondary education to the population of the appropriate age groups, a variable to assess the dynamics of prices, fixed capital formation as a percentage of the GDP, and the change in the labor force participation rate. Subsequent studies in this category used additional variables to assess FDI effects, namely, the strategy used to attract investment, the financial and institutional development, and the level of human capital.

Analyzing 46 developing countries over the period from 1970 to 1985 using the OLS method and generalized instrumental variable (GIV) estimations, Balasubramanyam, Salisu, and Sapsford (1996) concluded that FDI had a greater impact on countries that promote exports of products than on countries that have import substitution policies. The results are based on an equation aimed at explaining growth using the following variables: labor input, domestic capital stock, stock of foreign capital and exports.

Borensztein, De Gregorio, and Lee (1998), upon examining a panel of 69 developing countries over the period from 1970 to 1989, concluded that FDI contributed to economic growth through the transfer of technology. However, they noticed that this positive impact was conditioned by the absorptive capabilities of advanced technologies that must be available in the host countries at a certain level. Their results are based on an equation that explains economic growth using the following variables: initial GDP, government consumption, black market premium on foreign exchange, measures of political instability and political rights, a proxy variable for financial development, inflation rate, measure of the quality of institutions, human capital, FDI, and an interaction term built with FDI and human capital.

These results are consistent with those of Durham (2004), who found that FDI effects are subject to the absorptive capacity of the host countries, specifically, financial and

institutional developments. The estimations are based on equations that include initial GDP, human capital variables explaining economic growth rate, investment ratio, FDI, and different interaction terms with FDI. This constraint on financial development was also used by Alfaro et *al.* (2004). Using a panel comprised of OECD and non-OECD countries for the period from 1975 to 1995, these authors concluded that while FDI contributes significantly to economic growth, the local financial market is crucial to achieving these positive effects. The equations included dummy variables for sub-Saharan Africa and control variables such as initial GDP, human capital, population growth, and government consumption. These positive effect results, however, were not fully confirmed by studies based on cointegration methods, even under specific conditions.

Cointegration techniques have yielded mixed results. In a country-by-country study of 28 developing countries, Herzer, Klasen, and Nowak-Lehmann (2008) found neither a long-term nor a short-term effect of FDI on economic growth for a majority of the countries. Their analyses of long-term and short-term relationships between FDI and economic growth, however, did not include control variables, as in the above-mentioned studies. Using Granger causality tests, they found that there is no unidirectional long-term relationship between FDI and GDP.[9]

Based on a simple equation that uses capital investment and FDI variables to explain output growth, De Mello (1999) found that the long-term impact of FDI on economic growth in non OECD-countries may be either positive or negative as the results are explained by the macroeconomic instability and the severe international credit constraints for the period of interest (1970 to 1990). With respect to selected Asian

[9] Chowdhury and Mavrotas (2006) found contradictory results in selected economies.

countries, Baharumshah and Thanoon (2006) found that a long-term relationship exists between economic growth and the following variables: domestic savings, FDI, long-term debt, and short-term debt.

3. Specification of models

The objective of this study is to test the hypothesis of potentially significant effects of FDI on economic growth in the African region. Therefore, following approaches used in several of the above-mentioned studies, an augmented Solow model (Mankiw, Romer, and Weil, 1992), with control variables that have been widely used in the literature, is used as a basis.

For robustness checking and analyses of sensitivity, two types of equations are estimated and they are similar to the static panel data models estimated by Barro (1991), Garrison and Lee (1995) Alfaro et *al.* (2004) or Durham (2004) in one case, and to the dynamic panel data model estimated by Azman-Saini, Baharumshah, and Law (2010) in the other case. The main difference between these two broad categories of models is the inclusion of a lagged variable of the dependent variable in the case of by Azman-Saini, Baharumshah, and Law (2010). All the control variables are used in both categories of models and two dependent variables are analyzed consecutively to analyze the robustness of the results: (i) the economic growth rate of the gross domestic product (GDP) at constant 2005 prices in local currency, and (ii) the logarithmic value of the purchasing power parity (PPP) - converted gross domestic product (GDP) per capita at 2005 constant prices.

$$Y_{i,t} = \alpha . Y_{i,t-1} + \beta_1 . FDI_{i,t} + \beta_2 . X_{it} + \eta_i + \varepsilon_{i,t} \quad (1)$$

$$Y_{i,t} = \beta_3 . FDI_{i,t} + \beta_4 . X_{it} + \eta_i + \varepsilon_{i,t} \quad (2)$$

where *i* and *t* represent respectively the country index, and the time index. Y and FDI represent respectively the logarithmic value of the purchasing power parity (PPP)-converted gross domestic product (GDP) per capita at 2005 constant prices or the economic growth rate of the gross domestic product (GDP) at constant 2005 prices in local currency, and foreign direct investment in percentage of GDP at current prices. X is the matrix of control variables, while η and ε stand respectively for the country specific effect, and the residual errors.

The set of indicators considered in matrix *X* of consists of the following indicators:

- government consumption: in percentage of PPP-converted GDP per capita at current prices or in percentage of GDP at current prices if respectively the dependent variable is respectively the PPP-converted GDP per capita or the real economic growth rate (GOV);
- logarithm of the population size (POP);
- a human capital variable: life expectancy (LIFEX) or secondary gross school enrollment ratio (SEC) if respectively the dependent variable is respectively the PPP-converted GDP per capita or the real economic growth rate;
- change of the general level of prices (PRIC) if the dependent variable is the real economic growth rate;
- initial GDP at 2005 constant prices in US dollar for the year 1980 (GDP1980); and

– a *proxy variable* representing the domestic investment (*INVEST*) which is defined on the basis of gross fixed capital formation as in the case of government consumption.

The choice of the dependent variable has been guided by earlier studies which analyze the determinants of economic growth. For instance, among others, Fisher (1993), Balasubramanyam, Salisu, and Sapsford (1996), Durham (2004), and Baharumshah and Thanoon (2006) use the economic growth rate of the GDP at constant prices. Furthermore, while Mankiw, Romer, and Weil (1992), Alfaro et *al.* (2004), and Azman-Saini, Baharumshah, and Law (2010) use GDP per capita at constant prices or GDP per working age population in US dollar, I use PPP-converted GDP per capita at constant prices in US dollar as according to the comments of Perkins, Radelet, and Lindauer (2008), PPP data are used to take into account price differences between countries and to provide an assessment of the real volume of the GDP. In the latter case of the PPP-converted GDP per capita, it does not seem to be necessary to control the impact of inflation.

Many of the above mentioned variables were used by Borensztein, De Gregorio, and Lee (1995), Borensztein, De Gregorio, and Lee (1998), Garrison and Lee (1995), McGrattan and Schmitz (1999), Yabi (2010), and Savvides (1995). Government consumption was incorporated on the basis of Barro's argument (Barro, 1991; Garrison and Lee, 1995), which states that high level government consumption reduces economic growth by introducing distortions due to the resulting taxation or the government spending programs, which do not contribute to private sector productivity.

Population and gross secondary school enrollment are human capital variables that are integrated into the augmented Solow model analyzed by Mankiw, Romer, and Weil

(1992), and Barro (1991). While the impact of the gross secondary school enrollment on economic growth is expected to be positive, the impact of population is expected to be negative according to the Solow model (Mankiw, Romer, and Weil, 1992; Azman-Saini, Baharumshah, and Law, 2010). As there is a lack of yearly data on school enrollment rates during the period from 1980 to 2009, I use life expectancy as a proxy variable of the level of human capital like Azman-Saini, Baharumshah, and Law (2010). In fact, life expectancy represents the general health condition of a country, and good health conditions can have positive effects on education according to Smith (2009).

Having been widely used in several studies in past years, investment is a key variable in the Solow model (Solow, 1956; Mankiw, Romer, and Weil, 1992) and is a key determinant of economic growth.

It is expected that the sign of the coefficients associated with FDI would be positive as spillover effects may have been observed in African countries.

Inserting separately the following interaction term of FDI × SEC, as proposed in Azman-Saini, Baharumshah, and Law (2010); Li, and Liu (2005); Borensztein, De Gregorio, and Lee (1995); and Borensztein, De Gregorio, and Lee (1998), has also been be considered. The significance of the interaction terms implies that the marginal effect of FDI on growth depends on the level of SEC. An interaction term of FDI × LIFEX, was also inserted as applicable.

4. Data and methodology

4.1. Data

Two datasets are used to analyze the role of FDI in the economic expansion of African economy, and the potential role of absorptive capacities; one dataset for each dependent variable.

Dependent variable: Real economic growth rate (GDP, constant prices, local currency)

The dataset comprises 50 African countries that were observed during the period from 1980 to 2009. The dataset is made up of yearly data, thus resulting in 1,500 observations. National accounts aggregates in percentage of GDP – gross fixed capital formation and government consumption – as well as real GDP growth rate and price levels were extracted from the United Nations Statistics Division (UNSD) database. The general level of prices was represented by the deflator of the GDP.

Dependent variable: PPP-converted GDP per capita at 2005 constant prices, US dollar

The dataset comprises 50 African countries that were observed during the period from 1980 to 2009. This period was subdivided into six sub-periods of five years each, thus resulting in 300 observations. The simple mean of the variable was computed for each sub-period.

The following variables were extracted from the Penn Tables: PPP GDP per capita at 2005 constant prices, investment share of PPP-converted GDP per capita at current prices, government consumption share of PPP-converted GDP per capita at current prices, and population size. The choice of this data source was driven by the availability of long series.

Due to the unavailability of variables in the African region during the last three decades, it was assumed that the difference between the investment share of PPP-converted GDP at current prices and the FDI as a percentage of GDP at current prices would represent the domestic investment as a *proxy variable*. This derived variable can be considered as an instrumental variable that is positively correlated to the domestic investment in percentage of the GDP at current prices. While it would have been preferable to disaggregate the investment share into domestic and foreign investments, it was not possible to do so. This attempt to differentiate these two flows has limitations because there are compiled on the basis of two different international statistical standards: the system of national accounts of gross capital formation, and the balance of payments for FDI.

For both datasets, FDI inflows were extracted from the United Nations Conference for Trade and Development (UNCTAD) database. Data on the secondary gross school enrollment ratio and life expectancy were extracted from the World Development Indicators (WDI) database of the World Bank. Data on population were obtained from the UNSD database.

As Azman-Saini, Baharumshah, and Law (2010) observed that the construction of the interaction variables may lead to multicollinearity, the interaction terms were orthogonalized by using the following two-step procedure, as presented in Azman-Saini, Baharumshah, Law (2010). First, FDI × SEC was regressed on the FDI and SEC variables, and second, the residuals of the regression were used as interactions terms. The same steps were applied in the case of FDI × LIFEX.

4.2. Methodology

As there are differences in sizes of datasets, estimation strategies are different. For the yearly dataset of 1,500 observations, I perform static and dynamic panel data analyses while for the five-year period dataset, I only perform dynamic panel data analyses.

For the static panel data models, I use random effects models because the initial GDP already encompasses country specific effects. To address the issue of heterosckedasticity and autocorrelation, I use the feasible generalized least squares method (FGLS) to estimate the coefficients (Pirotte, 2011; Greene, 2012). Because the form of autocorrelation is not known accurately, common AR (1) and panel-specific AR (1) are tested.

For dynamic panel data models, I used instrumental variable (IV) methods. In fact, I am aware of the following issues: (1) economic growth is a determinant of FDI inflows in some studies (Habib and Zurawicki, 2002; Dabrek and Payne, 2002; Yabi, 2010); (2) domestic investments depend also on cyclic conditions resulting from economic activity; and (3) the economic growth rate, the level of human capital and the level of domestic investments can be determinants of FDI inflows (Alsan & Canning, 2006; Asiedu & Lien, 2011; Gui-Diby, 2012).

For the dataset with yearly data (T = 30 and N = 50), I use two different two stage least squares estimators: the Balestra and Varadharajan-Krishnakumar estimator (Balestra and Varadharajan-Krishnakumar, 1987) and the Baltagi's error component two stage least squares (EC2SLS) random effect estimator (Pirotte, 2011, p. 152). For this purpose, the lagged economic growth rate, domestic investment and FDI are considered like endogenous variables while other variables are considered like exogenous

variables. In addition to the existing exogenous variables of the equation, when necessary and applicable, I add other instrumental variables such as: lagged form of endogenous variables (one), first order difference of the economic growth, one lag of government consumption, one lag of life expectancy, GDP per capita, natural resource rent, the share of agriculture in the GDP at constant prices, and/or one lag of GDP per capita, natural resource rent, and/or the share of agriculture in the GDP at constant prices. We used lagged variable and first order difference of variables from the model like in the case of generalized methods of moments. The choice of the "new" variables was drawn from the list of variables highlighted in the literature on the determinants of investments. Sargan-Hansen over-identification test is performed to analyze the validity of the set of instruments. However, it has to be acknowledged that this choice possesses an arbitrary component which may reduce the robustness of the analyses. For this purpose, changing the dataset and the estimation method may be useful.

For the dataset with five-year period, I use generalized methods of moments (GMM).

GMM[10] were used to estimate the parameters of equation (1) even though methods such as two-stage least squares (2SLS) and three-stage least squares (3SLS) could have been used in a simultaneous equations framework. The decision to use GMM is justified by the fact that, according to Sevestre (2002), the 2SLS and 3SLS methods are particular cases of GMM and GMM controls simultaneity bias that may emerge from the existence of endogenous explanatory variables. The basic method is that developed by Arellano and Bond (1991), which uses internal instruments and independent variables used to perform the regression. Blundell and Bond (1998) contributed to the improvement of this method by proposing additional instruments as well as conditions

[10] All estimations were performed with the command *xtabond2* developed by Roodman (2009a).

of utilization based on the results of Arellano and Bond (1991) and Arellano and Bover (1995): the system generalized method of moment (SYS-GMM). It is the latter that has been used to estimate coefficients of equation (1) as this method has been found adequate for panel data with small *T* and large *N*. In our case, *T = 6* and *N = 50*.

Following the results of Roodman (2009b) on the number of instruments to be used for GMM, a limited number of instruments was used in a collapsed matrix format. Two-step and one-step estimator results are presented. For the one-step estimator, the Windmeijer correction was applied (Windmeijer, 2005). Globally, all variables were considered to be weakly exogenous or endogenous.

For all instrumental variables estimations, the Sargan/Hansen test was performed to test the validity of sets of instruments.

The variables $FSEC_{it} = FDI_{i,t} \times SEC_{it}$ and $FSEC_{it} = FDI_{i,t} \times LIFEX_{it}$ were considered as exogenous variables in all instrumental variable estimations, including SYS-GMM.

Arellano-Bond tests of autocorrelation of order one and two (Arellano and Bond, 1991) were performed to examine the hypothesis of no second-order and no first-order serial autocorrelations in the error term of the difference to exclude individual fixed effects.

5. Empirical results

5.1. Descriptive analyses

Table 2.1 presents the simple averages of the variables during the six 5-year sub-periods.

Table 2.1: Evolution of variables during the period 1980-2009: averages for the six sub-periods

Period	FDI (1)	FDI/GDP (2)	Y (3)	SEC (4)	INV (5)	GOV (6)
1980-1984	41.0	0.0109	1889.0	21.8	22.4	13.9
1984-1989	57.4	0.0131	1920.6	25.9	19.5	13.6
1990-1994	85.5	0.0157	1992.7	27.9	21.3	13.6
1995-1999	182.0	0.0354	2173.3	31.3	22.1	12.6
2000-2004	357.5	0.0454	2483.3	35.9	20.4	12.4
2005-2009	1064.6	0.0604	3074.7	43.0	23.6	12.1

Notes: FDI in millions of US Dollars (USD), Y is the GDP per capita in PPP-converted USD at 2005 constant prices, SEC in percentage, and INV and GOV in percentage of the PPP-converted GDP.

From table 1, it is evident that there is a structural break in the evolution of FDI in Africa as two sub-periods can be identified: 1980 to 1994 and 1995 to 2009. In fact, the absolute values of the FDI flows and the weight of FDI as a percentage of GDP more than doubled from the period from 1990 to 1994 to the period from 1995 to1999.

Table 2 presents correlation coefficients for the variables that are analyzed, and suggests that there is a positive but weak correlation between FDI and PPP-converted GDP per capita (Table 2.2B), but a stronger correlation between FDI and the real economic

growth rate (Table 2.2A) for all 50 African countries for the period from 1980 to 2009. The variation of *Y* is more strongly correlated to national investments in both datasets.

Table 2.2: Correlation matrixes of variables of interest [period: 1980-2009]

2.2A: Correlation matrix of variables based on the dataset with yearly data

	Y	**INV**	**FDI**	**POP**	**GOV**	**PRICE**	**LIFEX**
Y	1.00						
INV	0.28 (0.00)	1.00					
FDI	0.22 (0.00)	0.38 (0.00)	1.00				
POP	-0.00 (0.96)	-0.30 (0.00)	-0.13 (0.00)	1.00			
GOV	-0.05 (0.05)	0.21 (0.00)	0.04 (0.10)	-0.41 (0.00)	1.00		
PRICE	-0.04 (0.17)	-0.03 (0.21)	-0.01 (0.66)	0.05 (0.04)	-0.03 (0.20)	1.00	
LIFEX	0.08 (0.00)	0.25 (0.00)	0.00 (0.87)	-0.12 (0.00)	0.03 (0.21)	-0.03 (0.32)	1.00
GDP80	-0.04 (0.16)	-0.21 (0.00)	-0.14 (0.00)	0.82 (0.00)	-0.25 (0.00)	0.05 (0.04)	0.16 (0.00)

Notes: P-values of significance tests are in brackets below the coefficients. *Y* represents the real economic growth rate of the GDP.

2.2B: Correlation matrix of variables based on the five-year average dataset

	Y	**FDI**	**POP**	**GOV**	**INV**	**SEC**
Y	1.00					
FDI	0.12 (0.04)	1.00				
POP	-0.10 (0.08)	0.43 (0.00)	1.00			
GOV	0.02 (0.67)	-0.06 (0.28)	-0.27 (0.00)	1.00		
INV	0.34 (0.00)	-0.02 (0.75)	-0.24 (0.00)	0.01 (0.90)	1.00	
SEC	0.68 (0.00)	0.23 (0.00)	0.08 (0.15)	-0.07 (0.21)	0.32 (0.00)	1.00
GDP80	0.72 (0.00)	0.15 (0.01)	-0.06 (0.31)	-0.00 (0.98)	0.33 (0.00)	0.66 (0.00)

Notes: P-values of significance tests are in brackets below the coefficients. *Y* represents the PPP-converted GDP per capita.

Based on the above descriptive analyses, the following preliminary results can be drawn:

For the yearly dataset:

- The variability of the real economic growth rate may be mainly explained by domestic investment and FDI;
- Government consumption may explain economic growth to some extent and its impact seem to be negative;
- The role of life expectancy as an explanatory variable is likely to be significant but its impact is expected to be weak; and
- Domestic investment and FDI seem to hold significant correlation with several other explanatory variables.

For the five-year average dataset:

- the variability of *Y* may be mainly explained by the secondary gross school enrollment and domestic investment;
- the impact of the population size on economic growth may be negative or non-significant; and
- the impact of FDI on economic growth remains questionable as this variable does not necessarily explain a significant portion of the variability of the dependent variable *Y* given that the correlation coefficients and growth rates do not suggest such a conclusion.

An analysis of the above correlation matrix by sub-period does not yield results that are completely different from the ones above (see appendices). The only significant result is the increase of the correlation coefficient between FDI and GDPCAP between the two

sub-periods, the correlation was stronger during the period from 1995 to 2009 than during the period from 1980 to 1994.

Appendix 2.3 presents descriptive statistics for all variables, except population (a stock variable), used in the equation.

5.2. Econometric analyses

Table 2.3 presents results from random effects model estimations and FGLS estimations aiming at correcting heterosckedasticity and autocorrelation issues. In this table, columns (1) to (3) contain results of random effects model while columns (4) to (6) and columns (8) present results from FGLS estimations with common AR (1). Columns (7) and (9) present results from FGLS estimations with panel-specific AR (1).

Table 2.3: Results of regressions with annual data (1980-2009) - Dependent variable: Real economic growth rate - Random effects models and FGLS estimators

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Domestic investment	0.227***	0.193***	0.195***	0.109***	0.108***	0.0929***	0.110***	0.0927***	0.110***
	(10.75)	(8.748)	(8.839)	(7.229)	(7.081)	(6.125)	(7.080)	(6.040)	(6.930)
Population	1.329***	1.185***	1.229***	0.902***	0.857***	0.819***	0.873***	0.827***	0.883***
	(3.956)	(3.816)	(3.917)	(5.248)	(4.917)	(4.864)	(4.801)	(4.814)	(4.767)
GDP80	-1.160***	-0.988***	-1.091***	-0.765***	-0.770***	-0.713***	-0.721***	-0.728***	-0.754***
	(-3.454)	(-3.198)	(-3.468)	(-4.710)	(-4.649)	(-4.443)	(-4.139)	(-4.397)	(-4.174)
Life expectancy	0.0936***	0.0817***	0.0886***	0.0651***	0.0650***	0.0632***	0.0524***	0.0650***	0.0582***
	(2.820)	(2.608)	(2.805)	(3.499)	(3.508)	(3.523)	(3.055)	(3.578)	(3.328)
Government consumption	-0.0803***	-0.0697**	-0.0723***	-0.0641***	-0.0728***	-0.0690***	-0.0669***	-0.0691***	-0.0686***
	(-2.760)	(-2.529)	(-2.605)	(-3.645)	(-4.046)	(-4.002)	(-3.876)	(-3.980)	(-3.836)
Price	-0.0236	-0.0243	-0.0241		-0.0215	-0.0232	0.00376	-0.0230	0.00376
	(-0.928)	(-0.959)	(-0.953)		(-1.288)	(-1.368)	(0.370)	(-1.361)	(0.372)
FDI		0.114***	0.110***			0.114***	0.131***	0.112***	0.125***
		(4.009)	(3.882)			(3.633)	(4.750)	(2.959)	(3.449)
FDI × LIFEX			-0.00935**					-0.00105	-0.00141
			(-2.342)					(-0.279)	(-0.371)
Constant	0.182	-0.521	0.668	1.412	2.467	1.923	1.436	2.012	1.716
	(0.0430)	(-0.135)	(0.170)	(0.735)	(1.274)	(1.034)	(0.827)	(1.049)	(0.938)
Observations	1,482	1,423	1,423	1,482	1,423	1,423	1,423	1,423	1,423
Number of cross-sections	50	50	50	50	50	50	50	50	50
AR (1)	NA	NA	NA	Common	Common	Common	Panel	Common	Panel

*, **, and *** refer to 10%, 5%, and 1% significance levels, respectively. Figures in brackets represent t-statistics.

In general, table 2.3 shows that all the explanatory variables, excluding the change in the level of prices, have an impact on the real economic growth rate of African countries. The positive and negative signs of coefficients associated respectively to population (table 2.3) and interaction term (table 2.3) are difficult to interpret in the framework of the Solow model. As these results present some weaknesses due to the fact that endogeneity issues are likely to exist, I perform additional analyses to check the robustness of these results. These analyses use instrumental variables methods.

Table 2.4 presents results which are based on IV estimations. Columns (1) and (2) present results under the assumption that only FDI is an endogenous variable while, columns (3) to (6) present results under the assumption that FDI and domestic investment are endogenous variables. In columns (7) – (11), one lag of the real economic growth rate is included as an explanatory variable as in Equation (1) and in the estimation procedure as an endogenous variable. All the results are based on the method of Balestra and Varadharajan-Krishnakumar (1987), excluding the ones reported in columns (5) and (6) which contain results which are based on the Baltagi estimation method (EC2SLS).

Concerning the control variables, their impacts seem to be broadly consistent within the category of estimation method: instrumental variable methods understood as Balestra and Varadharajan-Krishnakumar or Baltagi's estimation method, and GMM. While results are consistent when using the same estimation method, it can be noticed that the significance of coefficients, associated to human capital, domestic investment and initial GDP, is drastically different when using the Balestra and Varadharajan-Krishnakumar or Baltagi's estimation method, and using the GMM estimators.[11]

[11] This difference can also be linked to the change of variables.

The result on the significant and positive impact of population remains throughout the analyses, and matches with the ones of Adams and Opoku (2015) and Agbloyor et *al.* (2014) who also analyze African countries. The positive sign of the impact of population could be explained by the Kremerian assumption on the positive correlation between the number of people and innovation or technological change (Kremer, 1993).

The impact of FDI inflows on real economic growth rate remains significant and positive in all categories of results during the period from 1980 to 2009, but the impact of the interaction term on economic is not significantly different from zero. These results would suggest that FDI inflows contributed to the economic expansion of the African economies but their impact was not constrained by human capital issues.

Table 2.4: Results of regressions with annual data (1980-2009) - Dependent variable: Real economic growth rate - Instrumental variable estimators

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Domestic investment	0.0589	0.0713	-0.0652	-0.0504	0.176*	0.164	0.462***	0.462***	0.462**	0.462**	0.462***
	(1.053)	(1.332)	(-0.395)	(-0.325)	(1.705)	(1.613)	(11.50)	(2.576)	(2.212)	(2.261)	(2.720)
Population	0.913***	0.903***	1.159**	1.149**	0.870**	0.881***	1.718***	1.718**	1.718**	1.754*	1.754**
	(2.924)	(3.023)	(2.328)	(2.384)	(2.554)	(2.841)	(4.073)	(2.061)	(2.168)	(1.794)	(2.342)
GDP80	-0.640**	-0.697**	-0.583	-0.601	-0.587**	-0.670*	-1.123***	-1.123	-1.123	-1.306	-1.306*
	(-2.182)	(-2.478)	(-1.261)	(-1.335)	(-2.172)	(-1.888)	(-2.751)	(-1.326)	(-1.441)	(-1.416)	(-1.841)
Life expectancy	0.0870**	0.0836**	0.131*	0.128**	0.0578	0.0656	0.0494	0.0494	0.0494	0.0546	0.0546
	(2.264)	(2.261)	(1.927)	(2.010)	(1.244)	(1.570)	(1.121)	(0.433)	(0.461)	(0.561)	(0.592)
Government consumption	-0.0385	-0.0379	-0.0364	-0.0373	-0.0512	-0.0489	-0.113***	-0.113	-0.113	-0.110	-0.110
	(-1.381)	(-1.414)	(-0.848)	(-0.902)	(-1.033)	(-0.947)	(-2.958)	(-0.970)	(-0.967)	(-1.039)	(-1.018)
Price	-0.0276	-0.0277	-0.0240	-0.0241	-0.0203	-0.0202	-0.0975**	-0.0975	-0.0975	-0.0961	-0.0961
	(-0.983)	(-1.003)	(-0.666)	(-0.683)	(-0.0333)	(-0.0392)	(-2.379)	(-0.107)	(-0.0778)	(-0.0856)	(-0.129)
FDI	0.579***	0.535***	1.162**	1.113**	0.348**	0.379*	0.250***	0.250**	0.250**	0.237**	0.237**
	(3.141)	(3.035)	(2.270)	(2.292)	(2.109)	(1.653)	(4.831)	(2.187)	(2.126)	(2.206)	(2.448)
FDI × LIFEX		-0.00772		-0.00116		-0.00991				-0.0247	-0.0247*
		(-1.613)		(-0.142)		(-0.831)				(-1.475)	(-1.867)
dum_year	-0.256	-0.495	1.594	1.434	-0.926	-0.954	-3.034***	-3.034**	-3.034***	-3.394***	-3.394***
	(-0.344)	(-0.664)	(0.951)	(0.860)	(-1.120)	(-0.832)	(-4.581)	(-2.283)	(-2.667)	(-2.595)	(-2.625)
Growth (-1)							-1.066***	-1.066***	-1.066***	-1.066***	-1.066***
							(-14.57)	(-13.80)	(-17.05)	(-16.43)	(-15.36)
Observations	1,378	1,378	1,373	1,373	1,373	1,373	1,423	1,423	1,423	1,423	1,423
Number of cross-sections	50	50	50	50	50	50	50	50	50	50	50
Sargan-Hansen Statistics	3.829	4.058	0.794	0.875	12.70	14.40	0.281	0.113	0.113	0.127	0.127
P-value Sargan-Hansen Statistics	0.147	0.131	0.373	0.350	0.241	0.212	0.596	0.737	0.737	0.722	0.722

*, **, and *** refer to 10%, 5%, and 1% significance levels, respectively. Figures in brackets represent t-statistics.

Analyses performed by sub-period (1980-1994 and 1995-2009) confirm that the impact of FDI inflows was not constrained by human capital but also that the impact of FDI inflows on economic growth was not strong during the period from 1980 to 1994, while during the period from 1995 to 2009, FDI inflows seem to have consistently contributed to the economic expansion of the African economies (see Appendices 2.4 and 2.5).

In the objective of using GMM to estimate equation (1), I tried to reduce the temporal dimension of the dataset by computing three-year averages for each variable; thus creating a dataset of 500 observations. However, results were not conclusive because the lagged variable explained must of the observed variations of the economic growth and coefficients associated to other variables were, in general, not significantly different from zero. These inconclusive results justify the usage of an alternate model with PPP-converted GDP per capita as dependent variable.

Table 2.5 presents the results of regressions based on the full sample of 50 African countries for the period 1980 to 2009 with PPP-converted GDP per capita as a dependent variable. In table 2.5, columns (1) and (2) present results based on one-step estimators with Windmeijer correction, while columns (3) and (4) present results based on two-step estimators.

Table 2.5: Results of regressions with five-year average data (1980-2009) – Dependent variable: PPP GDP per capita – System GMM estimators

Independent variables	(1) One-step	(.2) One-step	(3) Two-step	(4) Two-step
Y (t-1)	0.9386***	0.8809***	0.9587***	0.9177***
	(0.1041)	(0.1032)	(0.0606)	(0.0545)
FDI	1.8524**	1.7536**	2.0056***	1.8249***
	(0.7771)	(0.8626)	(0.3840)	(0.4127)
INVEST	0.0118**	0.0112**	0.0085***	0.0089***
	(0.0048)	(0.0052)	(0.0022)	(0.0022)
POP	-0.0377	-0.0646	-0.0043	-0.0245
	(0.0510)	(0.0582)	(0.0293)	(0.0320)
SEC	0.0003	0.0016	0.0010	0.0020
	(0.0033)	(0.0032)	(0.0019)	(0.0016)
GOV	-0.0111	-0.0124	-0.0116	-0.0112
	(0.0159)	(0.0172)	(0.0093)	(0.0098)
*FDI*SEC*		-0.0121		-0.0118
		(0.0164)		(0.0089)
A-B test for Ar (1)	-1.22	-1.10	-1.59	-1.56
	(0.224)	(0.272)	(0.113)	(0.119)
A-B test for Ar (2)	-1.27	-1.40	-1.33	-1.39
	(0.203)	(0.160)	(0.185)	(0.164)
Number of instruments	21	22	21	22
Hansen test	14.11	13.20	14.11	13.20
	(0.442)	(0.510)	(0.442)	(0.510)
Number of observations	250	250	250	250

Notes: ***, **, and * correspond, respectively, to 1%, 5% and 10% levels of significance. Standard errors of coefficients are in brackets below the values of the coefficients. For specification tests, p-values are under computed statistics tests. The *A-B test* denotes the Arellano-Bond test of serial autocorrelation.

Globally, the tests of Arellano-Bond indicate that there is no serial autocorrelation of order 1 or order 2 for all equations. Sargan/Hansen tests have not rejected the hypothesis regarding the validity of instruments used for estimations. Accordingly, from these two results, one can conclude that the estimated coefficients can be inferred. Generally, the signs of control variables, excluding domestic investment, are not significant. With respect to FDI inflows towards Africa, according to all four equations, the impact of the FDI inflows is significantly positive on economic growth. The result on the impact of FDI inflows on economic growth matches with the ones obtained with other models and estimation methods.

By performing the above analyses over the two sub-periods, the above results change slightly. Results of the estimations performed with the method of instrumental variables are presented in appendix 2.6.[12] From these analyses, it is evident that secondary gross school enrollment had a positive impact on economic growth during the period from 1980 to 1994, but not during the period from 1995 to 2009. These disparities may be explained by the argument raised by Savvides (1995) on the poor quality of educational statistics in Africa, even though some improvements have been noticed due to different capacity building programs implemented by several international and regional organizations such as the United Nations Economic Commission for Africa (UNECA) and the African Development Bank (AfDB).

[12] This method was used because of the number of available periods that could be used to perform the analysis; three periods per cross-section. Therefore, it was not possible to apply the GMM or the SYS-GMM.

Domestic investments had a positive impact on the economic growth rate for the period from 1995 to 2009. This was not the case, however, during the period from 1980 to 1994. In fact, during the period from 1980 to 1994, domestic investments had a positive impact only in equation at the 10% significance level.

Accordingly, an increase in FDI would generate economic growth. Indeed, this impact is greater than that of domestic investment, a result that is not consistent with that of Yabi (2010), Herzer et *al.* (2008), or Durham (2004) regarding developing countries in general. However, it is consistent with the findings of Blomsrtöm, Lipsey, and Zejan (1992); Balasubramanyam, Salisu, and Sapsford (1996); Borensztein, De Gregorio, and Lee (1998); and Baharumshah and Thanoon (2006).

Moreover, the interaction term is not significantly different from zero, which means that there are no contingencies for positive effects of FDI on economic growth in Africa. This result contrasts the findings of Borensztein, De Gregorio, and Lee (1998).

Results in appendix 2.6 indicate that the impact of FDI on economic growth (PPP-converted GDP per capita) was negative during the sub-period from 1980 to 1994 and positive during the period from 1994 to 2009.

The conflicting impacts of FDI inflows found in appendices 2.4, 2.5 and 2.6 may be due to the nature of the FDI inflows received between 1980 and 1994, as it was marked by the implementation of structural adjustment programs and the Washington Consensus, which were launched at the end of the 1980s and included a component on the liberalization of economies in general. As a result, several state-owned enterprises were sold to foreign investors who then reduced the size of the labor force to improve the profitability of their

acquisitions. Not surprisingly, unemployment rates increased and household consumption decreased.

Nonetheless, the impact of the absorptive capacity of countries (human capital) does not appear to be a key element in the spillover effects for the two sub-periods, a finding that confirms the results presented in table 2.5; the ones based on the system GMM approach.

To explain the differences in results, three elements must be examined: methodological issues, the sectorial orientation of FDI inflows in Africa, and determinant factors of spillover effects.

First, with respect to methodology, several factors can explain the discrepancies between the conclusions from this study and those of other researchers: differences in methods used, differences in the time frame, and differences in the variables used to analyze the problem. For example, this study used PPP converted aggregates rather than current and/or constant price aggregates as national accounts variables because the use of PPP converted aggregates increases the comparability of countries and provides more information on the real purchasing power of households compared with current price aggregates. Furthermore, while aggregates valued at constant prices could provide a picture of the purchasing power of households, the results would not be comparable across countries.

Moreover, the population size may not be an appropriate variable to perform analyses in the African region because of the irregularity of censuses and surveys. Estimations of the size of the population are based on non-exhaustive data as countries face several challenges with respect to the maintenance and the upgrading of their civil registration and vital statistics systems. Therefore, for a given country, the dynamics of the population are less likely to change from one year to the next. The method of estimation contributes also to the

explanation of differences. In fact, there is an endogenous relationship between FDI inflows and the economic growth (Li and Liu, 2005; Borensztein, De Gregorio, Lee, 1998). This issue cannot be claimed to have been completely addressed by using SYS-GMM or instrumental variables estimators. Simultaneous equations could also have been used.

Second, with respect to the orientation of FDI in Africa and the explanation of the insignificance of the impact of human capital, it seems that FDI inflows have been oriented during the past three decades mainly towards companies in the primary sector with a low level of human capital requirement, or a high level of physical and financial capital intensity. This assumption is confirmed by Asiedu (2006) and Gui-Diby (2012). Asiedu (2006) and UNCTAD (2008) found that countries that have natural resources were more attractive than those without such resources, while Gui-Diby (2012) found that in the African region, FDI flows were mainly hosted by countries with low value added of the manufacturing sector. Moreover, multinational enterprises have been primarily involved in the extraction and the exportation of raw materials or commodities, that is, activities that do not require a high level of knowledge or huge absorptive capacity. As a result, the main elements contributing to economic growth and related to FDI may include revenues, income of workers in the primary sector, and expenditures of the government resulting from the exportation of natural resources. Furthermore, it must be considered that connections with local firms are weak and resource-seeking investments are less likely to generate a critical number of direct and indirect well remunerated jobs; through for instance backward and forward linkages.

Third, with respect to the determinant factors of spillover effects, the following elements may be raised as per the theoretical model developed by Markusen and Venables (1999):

the intensity of the use of local input by MNEs compared with local enterprises, the fixed cost for the creation of enterprises, and the degree of replacement of imports. The intensity of the use of local inputs and the fixed cost of the installation of enterprises determine the possibility for local firms to benefit from backward and forward linkages resulting from the entry of MNEs. Moreover, according to these authors, the impact is more likely to be positive if the MNEs are replacing imports, as doing so reduces the likelihood of crowd-out effects due to the surplus of supply. In the African context, access to long-term loans and a low level of saving have always been issues faced, respectively, by entrepreneurs and banks. For example, in 2012, the number of depositors with commercial banks stood at 149 per 1,000 adults according to the World Bank database (WDI). The positive impact of FDI inflows during the second sub-period (1995 to 2009) is mostly likely related to the improvement of the business environment, as reported by UNCTAD (2008), which was favorable to both FDI and local investments. This improvement could have contributed to the emergence of more responsive local firms with respect to issues and challenges related to both supply and competition.

The above results may also raise the issue of the complexity of analyzing the impact of FDI on economic growth in the African region because of the lack of consistent long time series.

6. Conclusion and summary

The objective of this chapter was to assess the impact of FDI flows into 50 African countries during the period from 1980 to 2009. In this regard, panel data methods were performed. From the results of this study, it can be concluded that FDI inflows towards African countries have had a significant impact on economic growth during the past 30 years. However, this effect was not identical during the overall period. In fact, on one hand, when considering PPP-converted GDP per capita as the dependent variable, the impact of FDI on economic growth was negative during the period from 1980 to 1994 while it was positive for the period from 1995 to 2009. On the other hand, when considering real economic growth rate as the dependent variable, the impact of FDI on economic growth was not significantly different from zero during the period from 1980 to 1994 while it was positive for the period from 1995 to 2009. This suggests that the negative or non-significant impact of FDI for the period from 1980 to 1994 may be linked to the implementation in many African countries of structural adjustment programs, including privatization, the orientation of FDI in resource-seeking activities, weak economic links between multinational enterprises and local firms, and the low capacity of local enterprises to mobilize adequate resources to launch production. The positive impact for the period from 1995 to 2009 could be partially explained by the improvement of the business environment and the contribution of resource-based industries to economic growth due to the export of commodities.

Policy makers are therefore advised to design policies aimed at attracting foreign investors. While human capital has not been found to be a contingency to the impact of FDI on economic growth, maximizing the benefits from FDI would still require governments to improve the availability of a well trained workforce, and to improve the business environment. In the long run, it should also help countries to diversify the nature of FDI inflows.

However, this chapter presents some limitations related to the usage of a proxy variable for domestic investment, the unavailability of full annual time series for some indicators, and the lack of statistics to integrate other contingencies such as governance and the development of financial markets. The constraint on the availability of full time series for the secondary gross school enrollment was overcome by using the periodic averages of available data or using life expectancy as a proxy variable for human capital.

7. Appendices

Appendix 2.1: Correlation matrix of variables for the period 1980-1994

	Y	**FDI**	**POP**	**GOV**	**INV**	**SEC**
Y	1.00					
FDI	0.04	1.00				
POP	-0.09	0.65	1.00			
GOV	0.07	-0.16	-0.33	1.00		
INV	0.33	-0.07	-0.22	0.08	1.00	
SEC	0.71	0.19	0.09	-0.01	0.24	1.00

Appendix 2.2: Correlation matrix of variables for the period 1995-2009

	Y	**FDI**	**POP**	**GOV**	**INV**	**SEC**
Y	1.00					
FDI	0.11	1.00				
POP	-0.13	0.44	1.00			
GOV	0.00	-0.05	-0.24	1.00		
INV	0.36	-0.03	-0.27	0.12	1.00	
SEC	0.67	0.21	0.03	-0.11	0.39	1.00

Appendix 2.3: Descriptive statistics of the two datasets from 1980 to 2009

2.3.1 Dataset with yearly data

Variables	Mean	Standard deviation	Minimum	Maximum	Number of observations
Y	3,64	7,40	-51,03	106,28	1500
GOV	18,03	9,13	2,05	58,77	1500
FDI	2,85	7,21	-65,41	90,46	1500
INV	20,17	10,71	2,00	107,85	1500
IMP	40,39	25,14	1,87	178,71	1500
EXP	30,07	19,27	1,36	121,78	1498
LIFEX	53,12	8,24	26,82	74,45	1482
SEC	31,58	24,14	2,40	124,75	1043
PRICE	0,47	7,33	-0,36	267,54	1440

2.3.2 Dataset with five year averages data

Variables	**Mean**	**Standard deviation**	**Minimum**	**Maximum**
Y	2255.59	3095.27	155.44	24591.29
FDI	298.00	1015.55	-250.45	10781.23
FDI / GDP	0.03	0.05	-0.05	0.38
SEC	30.97	22.80	2.76	123.57
INV	21.55	11.85	-2.40	92.32
GOV	13.04	10.02	1.58	62.95

Appendix 2.4: Results of regressions with annual data (1980-1994) - Dependent variable: Real economic growth rate - Instrumental variable estimators

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Domestic investment	0.115**	0.0968**	0.0804**	0.109**	0.202**	0.141*
	(2.144)	(2.277)	(1.968)	(2.145)	(1.978)	(1.771)
Population	0.926	0.982*	0.846	0.922	1.948*	0.357
	(1.641)	(1.701)	(1.323)	(1.509)	(1.663)	(0.677)
GDP80	-1.117**	-1.105***	-1.083**	-1.101*	-1.839*	
	(-2.309)	(-2.634)	(-2.193)	(-1.941)	(-1.910)	
Life expectancy	0.249***	0.298***	0.257***	0.248***	0.415***	0.359***
	(3.137)	(3.522)	(3.597)	(3.056)	(3.048)	(2.776)
Government consumption	-0.0480	-0.0255	-0.0370	-0.0388	-0.0847	-0.0411
	(-1.062)	(-0.520)	(-0.783)	(-0.770)	(-1.156)	(-0.497)
Price	-0.0242	-0.0287	-0.0256	-0.0250	-0.0957	-0.0793
	(-0.0554)	(-0.0348)	(-0.0389)	(-0.0468)	(-0.0575)	(-0.0828)
FDI	0.0319	0.142	0.0692	0.0878	0.339*	0.402**
	(0.205)	(1.161)	(0.738)	(0.786)	(1.754)	(2.060)
FDI × LIFEX		0.0309*				0.0645*
		(1.673)				(1.854)
Growth (-1)					-1.035***	-0.623**
					(-5.260)	(-2.163)
Observations	633	633	639	639	679	679
Number of cross-sections	48	48	49	49	50	50
Sargan-Hansen Statistics	34.39	36.34	15.74	19.74	11.54	13.81
P-value Sargan-Hansen Statistics	0.0597	0.0509	0.151	0.102	0.317	0.182

*, **, and *** refer to 10%, 5%, and 1% significance levels, respectively. Figures in brackets represent t-statistics

Appendix 2.5: Results of regressions with annual data (1995-2009) - Dependent variable: Real economic growth rate - Instrumental variable estimators

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Domestic investment	0.254**	0.242**	0.195*	0.268*	0.464***	0.262**
	(2.078)	(2.364)	(1.710)	(1.798)	(3.076)	(2.049)
Population	-0.345	-0.0814	-0.358			
	(-0.556)	(-0.149)	(-0.777)			
GDP80	0.497	0.530	0.569	0.819**	1.032**	0.744*
	(0.658)	(0.860)	(1.073)	(2.486)	(2.507)	(1.707)
Life expectancy	-0.0808	-0.112	-0.0607	-0.120	-0.194*	-0.0611
	(-0.920)	(-1.297)	(-0.799)	(-1.297)	(-1.661)	(-0.533)
Government consumption	-0.0945	-0.110	-0.102	-0.172	-0.247	-0.243
	(-0.978)	(-1.148)	(-1.043)	(-1.109)	(-1.363)	(-1.467)
Price				0.0529	-0.127	0.0480
				(0.00896)	(-0.0250)	(0.00880)
FDI	0.237*	0.327**	0.395**	0.673**	0.713**	1.121***
	(1.829)	(2.212)	(2.479)	(2.499)	(2.055)	(3.175)
FDI × LIFEX	-0.0192		-0.0204*			-0.0398*
	(-1.356)		(-1.857)			(-1.950)
Growth (-1)				-0.476***	-1.010***	-1.067***
				(-4.505)	(-6.011)	(-7.349)
Observations	735	737	737	744	744	744
Number of code	50	50	50	50	50	50
Sargan-Hansen Statistics	31.86	15.27	12.87	3.962	2.409	4.725
P-value Sargan-Hansen Statistics	0.103	0.122	0.302	0.914	0.983	0.909

*, **, and *** refer to 10%, 5%, and 1% significance levels, respectively. Figures in brackets represent t-statistics

Appendix 2.6: Impact of FDI on PPP GDP per capita - Analysis by sub-period of the three-decade panel of data (1980-2009) for 50 African countries

Independent variables	**Period 1980-1994**		**Period 1995-2009**	
	(1)	(2)	(3)	(4)
Y (t-1)	0.9631***	0.9683***	0.9550***	0.9579***
	(0.0326)	(0.0341)	(0.0334)	(0.0336)
FDI	-2.1045***	-2.0183***	0.5131*	0.4967*
	(0.6632)	(0.6751)	(0.3006)	(0.3015)
INVEST	0.0030	0.0032*	0.0085***	0.0086***
	(0.0019)	(0.0019)	(0.0018)	(0.0018)
POP	-0.0027	0.0004	0.0087	0.0124
	(0.0144)	(0.0152)	(0.0166)	(0.0172)
SEC	0.0031**	0.0033**	0.0020	0.0018
	(0.0012)	(0.0013)	(0.0013)	(0.0013)
GOV	0.0020	0.0017	-0.0026	-0.0024
	(0.0018)	(0.0019)	(0.0027)	(0.0027)
FDI*SEC		0.0270		-0.0104
		(0.0356)		(0.0121)
Number of observations	100	100	100	100

Notes: ***, **, and * correspond, respectively, to 1%, 5% and 10% levels of significance. Standard errors of coefficients are in brackets below the values of coefficients. For specification tests, p-values are under computed statistics tests

Appendix 2. 7: List of countries

Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Côte d'Ivoire, Democratic Republic of Congo, Djibouti, Egypt, Equatorial Guinea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda, Zambia and Zimbabwe.

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Chapter 2: Foreign Direct Investment and the Industrialization of African Countries[13]

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1. Introduction

Over the last several decades, African countries have been exporting sizeable quantities and values of raw materials and commodities. They have generally failed, however, to diversify their international trade and their economy according to UNECA (2013): *(i)* the diversification indices published by the United Nations Conference for Trade and Development (UNCTAD) show that the structure of international trade for all African countries is highly concentrated, compared with the structure of the world average; *(ii)* the concentration of goods exports increased during the period from 1995 to 2012; and *(iii)* the share of primary products in exports is equal to at least 50% in three quarters of African countries, and 90% in one third of these countries.

It is recognized that this type of trade does not generate significant value added or enough jobs (UNECA, 2013) and that it increases countries' exposure to international exogenous shocks. One solution to the above mentioned issues could be industrialization because it can contribute to the increase of household consumption, the demand for intermediate goods (Rosenstein-Rodan, 1943; Fleming, 1955), and change in the main drivers of economic growth. In this regard, African countries have been called upon by different organizations to move towards more diversified economies because such a move would reduce the volatility of economic growth and bring confidence to investors.

Yet, achieving this objective would require additional financial and technical resources. Financial resources may reach countries through the participation of national private

investors, the involvement of foreign investors through foreign direct investment (FDI), or the mobilization of sizeable amounts of government resources, as many African countries are resource rich. Finding additional technical resources for initiating a "big push" would be more challenging, however, because private enterprises do not use the most advanced technologies. Therefore, attracting FDI could be a good policy option because foreign investors can bring financial assets as well as knowledge assets. In fact, previous studies have found that East Asian countries benefited extensively from FDI inflows during the transformation of their economies (Dahlman, 2009; Akkemik, 2009; Di Maio, 2009). Several studies, including Dong, Song and Zhu, (2011) and Borensztein, De Gregorio, and Lee (1998), find that host countries could benefit from FDI through different channels, such as forward and backward linkages and technological transfers. Markusen & Venables (1999) and Rodríguez-Clare (1996) have shown theoretically that FDI could be a catalyst for industrialization.

Nonetheless, to our knowledge, there is a lack of econometric studies that analyze the impact of FDI on industrialization with a special attention to African countries; therefore, this chapter attempts to fill this gap. Achieving this objective is important because FDI inflows to Africa have been increasing steadily, and it would be worth having a critical view on their impacts. Knowing whether policies that aim to attract FDI inflows were integrated in industrial policies would help to set a direction for a new generation of policies, providing that African countries desire to move in this direction. To this effect, the impact of FDI inflows on industrialization is analyzed with panel data from 49 countries observed during the period from 1980 to 2009.

The remainder of the chapter is organized as follows: Section 2 explains how FDI inflows can induce industrialization and presents the relevant review of the literature; Section 3 presents stylized facts on industrialization in Africa; Section 4 presents an overview of the data used and addresses econometric and methodological issues; Section 5 presents the empirical results and their interpretation, while Section 6 concludes and summarizes the results from the study.

2. Review of literature

It is worth noting that industrialization can be defined on the basis of national accounts indicators, and employment indicators. Industrialization can be defined as the increase of the value added of the manufacturing sector as a percentage of GDP (Chandra, 1992). In this regard, the realization of industrialization implies faster growth recorded in the manufacturing sector compared with other sectors. For Echaudemaison (2003), industrialization is observed through the increasing share of the secondary sector in terms of employment and GDP, and de-industrialization is observed when the tertiary sector gradually decreases in importance, accompanied by a crisis in traditional industries. De-industrialization is defined by UNIDO (2013) as the "long-term decline in manufacturing relative to other sectors," and is measured by the share of manufacturing employment in total employment.

From the above definitions, the analysis of the impact of FDI inflows on industrialization can be translated into two types of analyses: *(i)* one based on key components of the supply and use table (SUT) of the economy, a table that represents a set of national accounts transactions recorded by industries and products during a reference period (generally one year); and *(ii)* a second based on the impact on the sectorial distribution of jobs. If there is ongoing industrialization, the input matrix of the supply and use table, which records intermediate consumption of different industries by product, is expected to be modified, and the vector of production by industries is expected to be concomitantly altered. We consider this first set of effects as "direct impacts on industrialization." According to different studies, the phenomenon of technological transfer in the host economy can take place with the entry of FDI inflows in the manufacturing sector. The occurrence of this phenomenon would have an impact on the productivity of local firms in this sector and other related sectors, thus potentially impacting the industrialization process. We consider this type of effects as "indirect impacts on industrialization." While there can be an overlap between the two types of impacts, the main difference stems from the fact that direct impacts are mainly related to changes in goods or jobs, and indirect impacts result from the transfer of knowledge. Finally, in each country, there is a government that is supposed to play an important economic role by addressing market failures and improving its people's welfare; its actions and their impacts on FDI-led industrialization should be considered carefully. For example, in the domain of the training of the labor force, which supports the industrialization process, Rosenstein-Rodan (1943, p. 204) notes that: "*The automatism of laissez-faire never worked properly in this field*." Another point is that the government can help reduce the magnitude of potential negative spillovers. The following sections therefore

present theoretical and empirical studies on the direct and indirect impacts of FDI inflows on industrialization, and the role that can be played by the government in connection with these impacts.

2.1. Direct impacts of FDI inflows on industrialization

Two major theoretical models have been developed by Rodríguez-Clare (1996) and Markusen and Venables (1999). The model developed by Markusen and Venables (1999) analyzes this impact in terms of the number of enterprises, and can be used to analyze the impact on industrialization defined in terms of GDP or value added, while the second model can be used for the employment-oriented definition of industrialization. The model developed by Rodríguez-Clare's (1996) analyzes the above mentioned impact in terms of employment, specifically the "ratio of employment generated in upstream industries through the demand for specialized inputs to the labor force hired directly by the firm" (Rodríguez-Clare, 1996, p. 854). In general, these models' findings concur on the potential existence of positive spillovers under specific circumstances, which are presented in each model.

According to Markusen and Venables (1999), two effects emerge from the entry of MNCs: a competition effect and a linkage effect. The competition effect emerges from the fact that MNCs compete with domestic firms by producing substitutable products which can also be imported. The size of this effect increases with the size of the surplus of products present on the market, as compared to the initial supply of products without MNCs, and decreases

with the productivity of the local firms. Linkage effects arise from connections with local suppliers. Specifically, if the intensity of usage of local inputs by multinational firms is lower compared with that of local firms, the exit of local firms producing final goods will be followed by the closure of domestic firms producing intermediate goods because the demand for the latter will decrease. On the contrary, if multinational firms use more local inputs than *local* firms producing the final good, the number of firms producing intermediate goods will increase due to *backward linkages*. In the case of an increase in the demand for intermediate goods, Markusen and Venables (1999) predict that new domestic firms will be created to satisfy the demand of multinational companies, which will contribute to the reduction of the price of intermediate goods (in a monopolistic competition). The decrease in the price of intermediate goods would be beneficial to domestic firms producing final goods because their cost of production would decrease, and other domestic firms in the industry of final goods will be able to break-even and make non negative profits through *forward linkages*. The emergence of these new firms would then be beneficial to other local firms through other rounds of backward and forward linkages.

Pertaining to the number of firms or the size of the industry, the study by Blomström (1986) of Mexican plant level data aggregated at the four-digit level from 1965 and 1970 finds that an increasing presence of FDI in an industry increases the concentration of firms in an industry, meaning that less firms are present after the entry of the multinational.[14]

[14] These results correspond to the ones of Caves (1976) who finds, on the basis of Australian and Canadian data in the 1960s, that the entry of multinational companies into an industry can increase competition in that industry, reduce the profits of domestic firms in the same industry, and lead to a reshuffle of firms with the entry and exit of domestic firms.

Barrios, Görg, & Strobl (2005) provide similar results using Irish plant level data observed during the period from 1972 to 2000. They find competition effects at the early stage of the entry of a multinational, but it appears that positive externalities resulting from this exogenous event outpace the initial negative effect at a later stage, so that the general impact on the number of local firms producing the same type of final good (compared with the multinational) is positive. The authors suggest that this result can be explained by the fact that local producers need some time to adjust and improve their capacities. It can then be assumed that the increase or decrease in the number of firms will result, respectively, in higher or lower manufacturing outputs (value added or employment), which will subsequently modify the matrix of intermediate consumptions, at least in the short-run. Although the primary objective of Liu (2002) was not to analyze the impact of FDI on industrialization in China, the dependent variable is the value added generated by firms, and as such, the study can be considered as a contribution to understanding this issue. The author finds a statistically significant and positive impact of the presence of FDI on the value added generated by firms in the Shenzhen Special Economic Zone. By extrapolation, and according to the above definitions, these findings confirm the fact that FDI could foster industrialization.

Rodríguez-Clare (1996) analyses the impact of FDI on the economy in terms of jobs creation, and the author's conclusions concur with those of Markusen and Venables (1999) on the necessity for the enterprise to use intensively local inputs toward the objective of creating more local jobs, thus increasing forward and backward linkages. Two key conditions to achieve this objective are analyzed by Rodríguez-Clare (1996): the good produced by the multinational firm should be highly complex because the production of the

final good will require access to a variety of inputs, and there is a high costs of communication between the host and home countries of FDI as they will increase the necessity of using local inputs. On the basis of a multisectoral model based on that of Rodríguez-Clare (1996), evidence of backward linkages is found by Alfaro & Rodríguez-Clare (2004) using firm level data from Brazil (dating 1997 to 2000), Chile (dating 1987 to 1999) and Venezuela (dating 1995 to 1999). However, the authors find insignificant horizontal spillover effects due to the entry of multinational companies. Macroeconomics analyses on the impact of FDI inflows on employment have also been performed by Kang and Lee (2011) using panel data from OECD countries dating from 1970. The authors find a significant positive impact on industrialization - measured by the share of manufacturing in total employment or total value added - for inward FDI flows and a negative impact for outward FDI flows. On the contrary, Kaya (2010) finds that FDI inflows did not have a significant impact on industrialization in 64 developing countries during the period from 1980 to 2003.

2.2. Indirect impacts of FDI inflows on industrialization

The indirect impacts of FDI inflows on industrialization emanate from technological transfer. Basically, technological transfers can increase the productivity, value added, and profit of an enterprise. In terms of the analytical framework developed by Markusen and Venables (1999), an increase in the profit of one local firm will attract more local investors

to the activity until the profit of each firm is equal to zero, or equilibrium. Technological transfers can be realized through the acquisition or licensing of a technology or through labor mobility (see (Fosfuri, Motta, & Rønde (2001) and Glass & Saggi (2002) for theoretical explanations on spillovers due to the mobility of workers). The number of firms and jobs in the manufacturing sector and the volume of manufactured outputs (final and intermediate goods) would increase depending on the magnitude and the strength of backward and forward linkages for upstream and downstream firms, respectively, while horizontal spillovers will depend on the fluidity of the labor market and the capacity to acquire technologies.

In particular, on one hand, upstream local firms, which supply intermediate goods to multinational and domestic firms, can have access to foreign technology from the MNC through the training of its staff, the recruitment of former staff of multinationals, or a direct licensing/acquisition of technology, i.e., vertical spillovers. All these factors would contribute to the production of final goods that meet standards set by the headquarters of the MNC. On the other hand, domestic firms in the multinational's industry would be able to increase their productivity by purchasing improved inputs from upstream firms, hiring former staff of multinationals, addressing inefficiency issues or strengthening their research and development activities to copy the multinational's products or improve their own products by imitating multinationals (Görg & Greenaway, 2004, pp. 173-174). This situation would also contribute to the development of more competitive domestic firms operating in the industry of the multinational, i.e., horizontal spillovers. According to extensive reviews of the literature performed by Görg & Greenaway (2004), Smeets (2008), Harrison & Rodríguez-Clare (2010), Keller (2010), and the meta-analyses performed by

Görg & Strobl, (2001) and Wooster & Diebel (2010), however, empirical studies analyzing the existence of vertical and horizontal effects resulting from FDI inflows provide mixed results in terms of productivity.

Concerning labor mobility, Görg & Strobl (2005) examine firm level panel data from Ghana observed during the period from 1991 to 1997 and find that domestic firms owned by former employees of multinationals exhibit greater productivity compared with other domestic firms. As noted by Smeets (2008), however, it is not clear if the same conclusion can be drawn for other employees. Thus, the analysis of the impact of labor mobility of former MNC's employees on the productivity of firms has so far been based on the analysis of the increase of wages in sectors with multinational companies. From this type of analysis, it can be concluded that domestic firms are more efficient and offer higher wages to attract skilled workers; however, the increase in wages can also be the advance indication of an increasing scarcity of skilled workers. The latter case is not automatically a positive development for actual and potential domestic firms if they have not increased their productivity, as their costs of production would increase and they would face challenges in recruiting labor.

Pertaining to vertical (productivity) spillovers, on the basis of firm level data, the associated coefficient is found to be positive and significant by Sjöholm (1999) in Indonesia in 1980 and 1981, Javorcik (2004) in Lithuania during the period from 1996 to 2000, Liu (2008) in China during the period from 1995 to 1999, and Javorcik & Spatareanu (2008) in Romania during the period from 1998 to 2003. However, Javorcik (2004) and Javorcik & Spatareanu (2008) note that these positive vertical spillovers exist only when multinational firms have joint venture initiatives with local enterprises. The effect would be insignificant with 100%

foreign capital according to the conclusions of Javorcik (2004) and Javorcik & Spatareanu (2008). While there seems to be a consensus concerning the potential existence of positive and statistically significant *backward* productivity spillovers due to FDI in specific contexts, *forward* productivity spillovers have not been widely confirmed. For instance, Bwalya (2006) in the case of 125 Zambian manufacturing firms during the period from 1993 to 1995 and Kugler (2006) with Colombian manufacturing plants observed between 1974 and 1998 did not find significant forward linkages. It is only recently that Xu & Sheng (2012) found positive forward linkages and negative backward linkages in the case of the Chinese manufacturing industry between 2000 and 2003. The authors explained the negative backward effects by Chinese policies, which encouraged the importation of raw materials and equipment by foreign firms, whereas positive forward effects emanate from the purchase of high-quality intermediate goods at low prices.

With reference to horizontal (productivity) spillovers, as for the other types of spillovers, results have also been mixed. According to the literature reviews by Harrison & Rodríguez-Clare (2010) and Keller (2010) prior to the study of Aitken & Harrison (1999) who find non-significant horizontal spillover effects for 4,000 Venezuelan industrial plants observed during the period from 1976 to 1989, positive spillover effects of FDI were found in many of studies, including: Globerman (1979) in Canada with industry-level data observed in 1972, Blomström & Persson (1983) for the Mexican manufacturing industry observed in 1970, and Borensztein, Gregorio, & Lee (1998) in 69 developing countries observed during the period from 1970 to 1989 at the industry level. For Aitken & Harrison (1999), this result can be explained by the fact that foreign investors chose to invest in the most productive sectors. Non-significant effects are also found by Haddad & Harrison

(1993), Girma, Greenway, & Wakelin (2001), (Liu, 2008) and Barbosa & Eiriz (2009) in Morocco, the United Kingdom, China and Portugal, respectively. Haddad & Harrison (1993) and Girma, Greenway, & Wakelin (2001) explain their results by domestic firms' low level technical capabilities, (Barbosa & Eiriz, 2009) suggest that it is due to competition effects, while Liu (2008) associates it with the short-term effects of FDI that will become positive on the long-run. While a number of recent studies find positive and significant spillovers due to FDI on the basis of the variables proposed by Aitken & Harrison (1999), a few others, such as Konings (2001) studying transitional economies during the period from 1993 to 1997, Hu & Jefferson (2002) examining Chinese firm-level data from 1995 to 1999, Waldkirch & Ofosu (2010) studying Ghanaian firms observed during the period from 1992 to 1998, and Xu & Sheng (2012) find negative horizontal spillovers. Their main explanation is that competition effects are sizeable compared with technological transfer.

2.3. Government: Spurring positive impacts of FDI inflows on industrialization

One key element emerges from the above literature: FDI inflows are not always a blessing for host countries. Maximizing their positive impacts depends on several different factors: the existence of competition effects, multinationals' reliance on local inputs, and the mobility and existence of a skilled workforce, to name a few. Ignoring these factors can result in job destruction and the decline of social welfare. In this regard, the government

may intervene to limit negative outcomes resulting from the entry of FDI. As such, industrial policies would be and have been essential in many countries, particularly in Asian countries that have benefited from FDI inflows. Essentially, these policies should aim at reducing the exit rate of domestic firms from the market, supporting domestic firms to catch up to MNCs, stimulating vertical linkages, and attracting the right categories of FDI inflows. While many economists can criticize government interventions, we are of the view of Bjorvatn and Coniglio (2012), who state that: "*Clearly, the presence of government failure is not by itself a justification for reduced government intervention."* Thus, the efficiency of government interventions should be improved.

2.3.1. Attracting the "best" categories of FDI inflows

In general, theoretical models explaining industrialization assume that either there is local market for the final product, as in studies by Murphy, Shleifer, and Vishny (1989a, 1989b), Rodríguez-Clare (1996), and Markusen and Venables (1999), or that industrialization is export-led (Trindade, 2005). It is less likely that resource-seeking FDI inflows, compared with market-seeking FDI, contribute directly to a country's industrialization unless the country processes raw resources prior to exporting them. To increase a country's attractiveness to the "best" foreign investors for industrialization, the government should improve the business environment by unlocking institutional bottlenecks, ensuring political stability, providing infrastructure, and training the potential labor force. Additionally, the

government should ensure access to a market.[15] According to Dahlman (2009), the Chinese authorities made extensive use of FDI targeting strategies with the following elements: the establishment of special economic zones to provide access to advanced technology and world-class inputs, the construction or availability of efficient transport and service infrastructures, and access to a large market. Singapore's government also utilized FDI targeting strategies. Pertaining to the business environment, as Da Rin and Hellmann (2002) find that large banks can play a catalytic role for industrialization through the allocation of credits to a critical mass of firms, the government could be expected to create a strong legal framework that encourages the establishment of large banks, including foreign subsidiaries, in support of its efforts to move the industrialization agenda forward. This initiative would then contribute to the "optimal" allocation of credit to firms, particularly local firms in the manufacturing sector that is under development with the support of the government. The financial sector was essential for Japanese firms, according to (Odagiri & Goto, 1996). Improving the business environment in general and having a strong financial sector would help decrease firms' entry costs, and according to Markusen and Venables (1999), the entry costs are essential when using FDI as catalyzer of industrialization.

[15] See Mucchielli & Mayer (2005), Asiedu (2006), and Asiedu & Lien (2011) for literature reviews concerning the determinants of FDI inflows.

2.3.2. Reducing the exit rate of domestic firms from the market

According to Markusen and Venables's (1999) model, some domestic firms in the MNC's sector will exit from the market as some of them will record negative profits due to lower sales (competition effects) and sizeable fixed costs. The productivity of domestic firms would therefore deteriorate, and the government can be expected to intervene to address this issue. Fixed costs could be reduced through access to loans from large banks at competitive rates,[16] or through direct government interventions in other domains such as transport, education, investment coordination, and research and development (R&D).

The proposed direct role of the government in the industrialization process, with appropriate policies, can be dated back to (Rosenstein-Rodan, 1943) and the theory of "Big Push Industrialization." Rosenstein-Rodan (1943) asserts that the government should be involved in training the labor force and coordinating investment projects. Coordinating investment projects aims at developing a set of complementary industries that sustain demand and provide a market for firms, while training is perceived as a public good because trained workers are not obliged to remain at one firm. Through this coordination exercise, firms would be more profitable or less unprofitable.

Murphy, Shleifer, and Vishny (1989b), who initially formalized the theory of the Big Push industrialization, propose a stronger role for the government: *(i)* to provide subsidies to firms to sustain the industrialization process; *(ii)* to build infrastructure that is required for

[16] See Da Rin & Hellmann (2002) on the role of banks in industrialization.

increasing the productivity of the private sector (power station, roads, railroads, airports, seaports, etc.); and *(iii)* to step in by unlocking capital constraints and reducing the uncertainty or risk, as the size of the projects and the time required to accomplish them can reduce private sector participation. These actions would help decrease production costs (fixed and variable).

While Bjorvatn & Coniglio (2012) generally agree with Murphy, Shleifer, and Vishny (1989b) on the possible government interventions listed above, the authors also propose the establishment of state owned enterprises (SOEs) as a means of supporting development of the private sector through aggregate demand. Such actions are expected to be followed by government retraction after a stronger manufacturing base has been developed (Bjorvatn & Coniglio, 2012). These types of actions can help domestic firms to survive after the entry of an MNC. According to the results of Bjorvatn & Coniglio (2012), who analyze the role of the government in the industrialization process, developing countries would need government interventions, such as those mentioned above, because failures of coordination are generally important, whereas developed countries would need modest interventions.

For instance, according to Dahlman (2009), results from the Chinese and Indian manufacturing sectors can be explained by the implementation of the following policies: infant industry protection, direct state ownership, selective credit allocation, favorable tax treatment, tariff and non-tariff protection, FDI targeting, local content requirement, intellectual property laws, government procurement for domestic firms, and the promotion of large domestic firms. Rodrik (1996) and Rodrik, Grossman, & Norman (1995) estimate that East Asian countries widely utilized all the above mentioned policies and, according to (Di Maio, 2009, p. 126), the implementation of these policies was time-bound.

2.3.3. Supporting domestic firms to catch up MNCs and stimulating vertical linkages

According to the empirical study of Barrios, Görg, & Strobl (2005) in Ireland, the entry of MNCs results in the net exit of domestic firms from the market in the short-term, and a slow adaptation of domestic firms to competition from MNCs that resulted in the net entry of domestic firms in the long-run. This conclusion is plausible because firms internationalize their activities only when they have a specific advantage compared with local firms, and they are able to keep their comparative advantage during a limited time period. Due to the competition effect, local firms are expected to increase their productivity, an objective that can only be achieved by having access to more advanced technologies or technical capabilities. In this regard, in addition to the above mentioned industrial policies, innovation policies implemented by the government would be critical. According to the World Bank (2010), innovation policies can be defined as policies that seek to insure the dissemination and use of "technologies or practices which are new to a given society" (World Bank, 2010, p. 4). To foster the development of national capabilities, these innovation policies should aim to: strengthen the education system so that graduates have key skills and capabilities for innovation; stimulate research and development activities as well as knowledge sharing; improve the business environment by encouraging competition and strengthening the legal framework; and support innovators (World Bank, 2010). Several generalized facts can be drawn from the Asian experience to support an

active government role in fostering the productivity of local firms and encouraging different spillovers effects through education and R&D.

Concerning education and training, the Chinese government invested heavily in its education system, has approximately 40% of its student in engineering and sciences (Dahlman, 2009, p. 313), has many tertiary-level students abroad,[17] and constantly provides training for its actual labor force in the manufacturing sector as well as the rural population coming to cities. In Japan, practical education programs (engineering, accounting, commerce, business administration) were implemented at the expense of purely scientific programs (Odagiri & Goto, 1996, p. 261). Similarly, the Taiwanese and South Korean governments invested massively in education (Di Maio, 2009, p. 117).

Pertaining to R&D activities and knowledge sharing, we can cite the following cases, among others: *(i)* the establishment of the Industrial Technology Research Institute (ITRI) in Taiwan in 1973 to acquire and disseminate foreign advanced technologies among Taiwan's firms; *(ii)* in South Korea, the funding of private R&D activities with special public funds and the provision of advantageous fiscal packages related to the acquisition of the foreign advanced technologies (subsidies for the transfer costs of patent rights and tax exemptions on income from technological consulting and for foreign engineers) (Di Maio, 2009, pp. 112-113); and *(iii)* in China, the Spark Program and the Torch Program to disseminate rural and high technologies, respectively, as well as the 15-year Science and Technology Plan with public expenditures for R&D, which was announced in 2005

[17] Dahlman (2009, p. 313): In 2005, more than 16% of the 2.7 million students studying abroad were from China, excluding Hong Kong.

(Dahlman, 2009, p. 323). Finally, local content requirements have been also used to strengthen backward linkages and foster the transfer of technologies in China with training requirements.

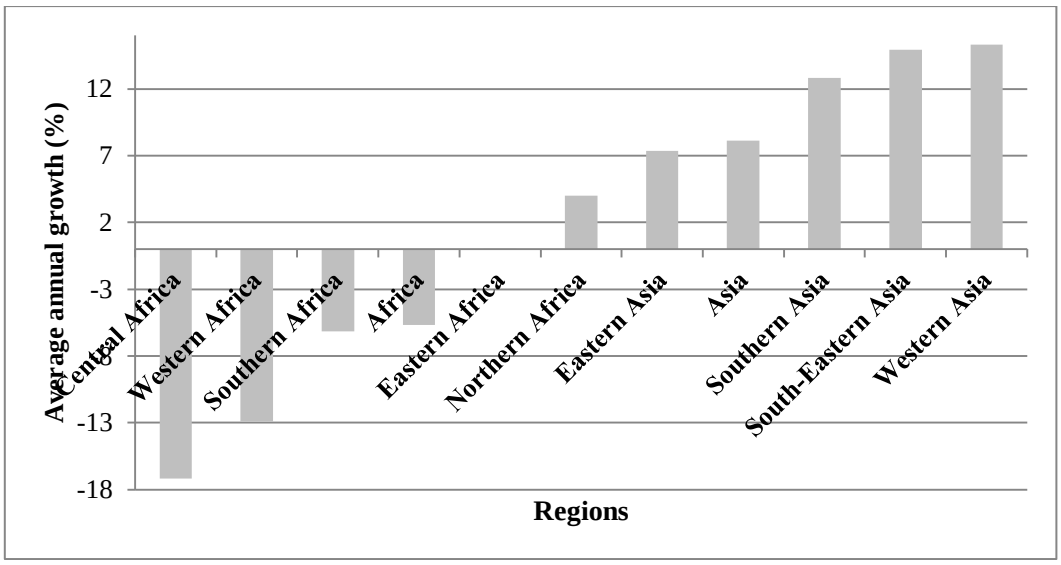
To conclude this section, the magnitude and sign of the direct and indirect impacts of FDI on industrialization are not easy to predict; however, based on the above literature, one can draw the following conclusions: FDI inflows are not always beneficial for receiving countries, and the government and the financial sector can play important roles during the industrialization process. This chapter therefore attempts to shed some light on the impact of FDI on industrialization in African countries by taking stock of the above mentioned factors.

3. General Facts on Industrialization in Africa

According to regional statistics, industrialization has not really taken place in Africa as an entire continent. The share of value added of the manufacturing sector decreased at an average rate of 5.68% in Africa over the period from 1980 to 2009, while in Asia, this share increased at an average rate of approximately 8% over the same period (see Figure 3.1). This situation is also reflected in the evolution and positioning of the diversification indices

of African countries compared with developing countries in Asia and the Americas.[18] The international trade of African countries has been less diversified than that of Asian and American developing countries (see figure 3.2), and did not change significantly during the period from 1995 to 2013.

Figure 3.1: Average annual rate of change in the shares of the value added of the manufacturing sector in Africa and Asia from 1980 to 2009[19]

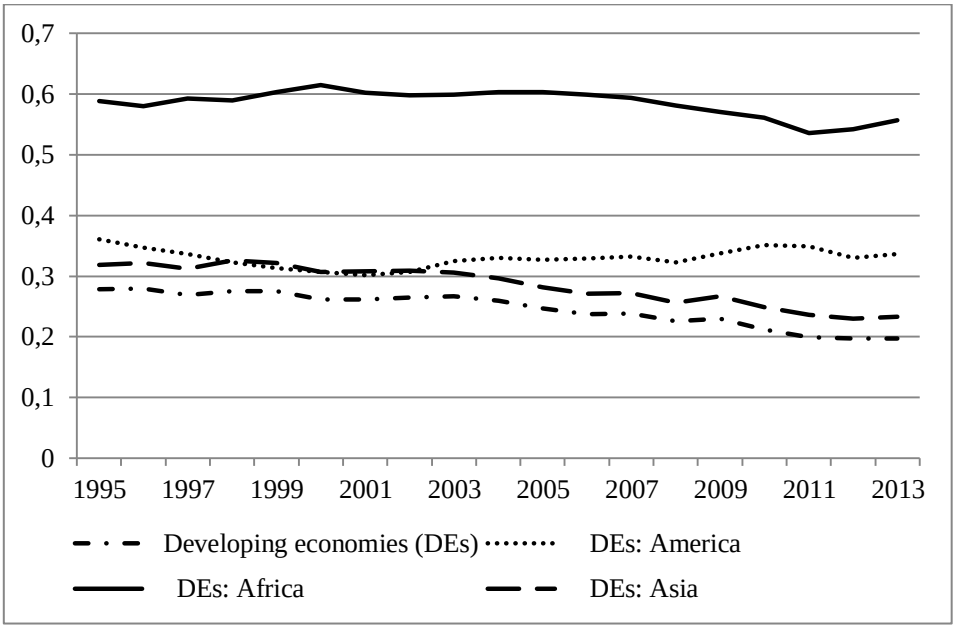


Source: Authors' calculation based on data from the United Nations Statistics Division (UNSD).

[18] The diversification index, which is a modified Finger-Kreinin index, provides a measure of the difference between the structure of exports by product of a given country and the structure of world exports of the world. An index value close to one indicates a large difference from the world average.

[19] See the country classification in Appendix 1.

Figure 3.2: Evolution of diversification indices in selected regions



Source: Authors' calculation based on data from the United Nations Conference on Trade and Development (UNCTAD)

An analysis of African sub-regions shows that it is only in Eastern and Northern Africa where efforts have been made to stabilize manufacturing output. At the same time, Asia and its sub-regions have seen their manufacturing sectors grow at a minimum of 7.34% on average during the period of study (Cf. Figure 3.1 and see appendix 3.1).[20] Table 3.1 presents the evolution of the shares of the value added of the manufacturing sector by decade. Central Africa and Western Africa stand out as the worst performing regions in terms of industrialization due to ongoing de-industrialization.

[20] The average annual growth rate is obtained by computing the mean of the growth rate of the share of the sector in the GDP computed at the sub-regional level. Sub-regional and regional aggregate national accounts data have been computed by the United Nations Statistics Division (UNSD).

Table 3.1: Evolution of the shares of value added of the manufacturing sector (in %)

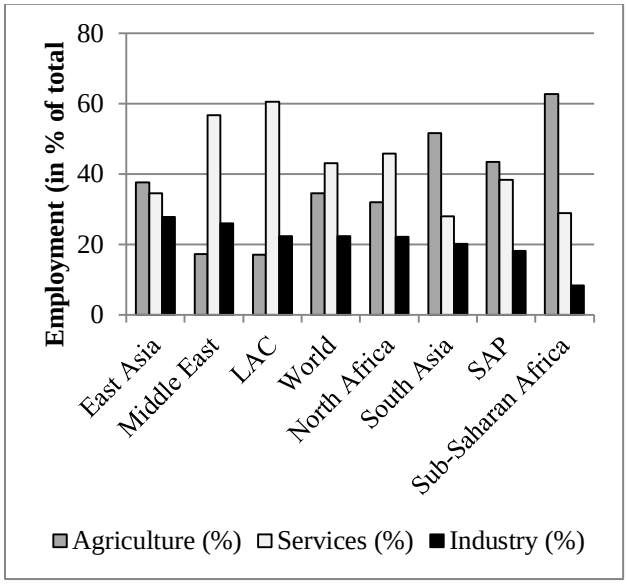
Regions/Years	1980-1989	1990-1999	2000-2009
Africa	12.82	12.22	11.41
Eastern Africa	9.77	10.02	9.77
Central Africa	10.15	7.32	6.85
Northern Africa	10.18	11.10	10.99
Southern Africa	20.38	18.74	17.94
Western Africa	8.22	7.72	6.20

Source: Authors' calculation based on data from the United Nations Statistics Division (UNSD).

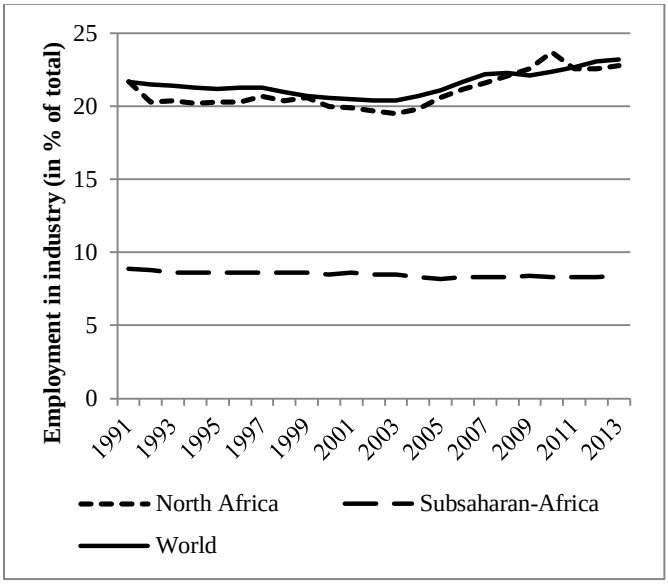
These shifts in manufacturing output were accompanied by changes in other sectors. In Western Africa, the share of agriculture, hunting, forestry, and fishing industries increased from an average of 28.1% from 1980 to 1989 to 31.9% from 2000 to 2009. The share of activities in mining and utilities industry of Central Africa jumped from an average of 31.4% recorded from 1980 to 1989 to 46.9% from 2000 to 2009. Transport, storage and communication activities increased mostly in Southern Africa, with their shares standing at 9.4% from 2000 to 2009, compared with an average of 6.4% recorded from 1980 to 1989.

Figure 3.3: Employment by sector (as % of total employment)

3A: Structure of employment by sector



3B: Employment in the industrial sector, 1991-2013



Notes: Acronyms: LAC= Latin America and the Caribbean; SAP: South-East Asia and the Pacific

Sources: Authors' calculation based on data from the International Labor Organization (ILO), KILM 8th edition.

At the regional level, the small size of the manufacturing sector in GDP is also reflected in the number of jobs in the manufacturing sector. Moreover, according to ILO estimates (KLM, 8th edition), the share of employment in the manufacturing sector in Sub-Saharan Africa was well below 9% during the last twenty years, far from the world average. It is only in North Africa that the share of employment in the industrial sector has been close to the world average, but there has not been a drastic increase of jobs in the industrial sector (See Figure 3.3).

Therefore, on the basis of UNIDO's definition of de-industrialization/industrialization, which is based on employment indicators, African countries did not industrialize. National account data, however, which are the basis of the definitions of industrialization provided by Chandra (1992) and Echaudemaison (2003), suggest that there was a de-industrialization of African countries.

This would mean that a constant share of the employed active population in the manufacturing sector produced less manufactured products and was thus less productive.

4. Specification of the model, estimation strategy and data issues

4.1. Variables

Dependent variable

The objective of our analysis is to assess the impact of inward FDI on the industrialization process in Africa. Two indicators may be used to measure industrialization according to Chandra (1992), Echaudemaison (2003), and UNIDO (2013): the value added of the manufacturing sector as a percentage of the GDP (constant prices), and the share of employment in the manufacturing sector in total employment. Dodzin and Vamvakidis (2004) and Kang and Lee (2011) use the valued added of the manufacturing sector as a percentage of GDP (at constant prices), while Kaya (2010) and Kang and Lee (2011) use the share of employment in the manufacturing sector. Because of limited data availability of disaggregated employment data for African countries during the period of study, we will focus the analysis on the above-mentioned national account aggregate as the dependent variable and will report results with employment data for information purposes only.

Explanatory variables

The level of household income and market size are essential elements of the big push industrialization theory (Murphy, Shleifer, and Vishny, 1989a, 1989b). Different studies, including those of Rowthorn and Ramaswamy (1997), Rowthorn and Ramaswamy (1999) Kaya (2010), Kang and Lee (2011), and Dong, Song, and Zhu (2011), find that this variable has a positive impact on industrialization. These studies mainly use GDP per capita as a proxy for the level of income. To use data that are free of exchange rate fluctuations, to represent the potential real purchasing power of households and to reduce the issue of heteroskedasticity, the logarithm of the average real GDP per capita at purchasing power parity (PPP) in 2005 constant prices (GDPCAP), is used.

One element of the big push industrialization proposed by Murphy, Shleifer, and Vishny (1989b) and Rosenstein-Rodan (1943) is summarized in this statement: *"[…] simultaneous investment by many firms can become profitable even when each loses money investing in isolation"* (Murphy, Shleifer, and Vishny, 1989b, p. 1016). These simultaneous investments are expected to increase the aggregate demand through income and the size of the market for all firms. Moreover, authors such as Rowthorn & Ramaswamy (1997) and Kang and Lee (2011) and Kaya (2010) find a positive impact of investment on industrialization for both OECD countries and developing countries. Rowthorn and Ramaswamy (1997) explain this by the fact that investments generate a demand for manufactured products, while Kaya (2010) suggests that returns from domestic investments are more likely to be reinvested in the home country. On the basis of the above elements, the impact of investment is likely to be positive, and investment will be represented by the gross fixed capital formation (INV) in percentage of GDP at current prices.

According to the general facts of the African region, countries appear to have de-industrialized as the value added of the manufacturing sector as a percentage of GDP decreased. The literature on de-industrialization highlights two main factors that can explain this phenomenon: the level of income and international trade. Concerning income levels, there may be a positive correlation between the level of income and industrialization, which however becomes negative when the level of income reaches a certain point. This is known as the inverted-U theory of industrialization, an assumption based on Engle's Law. Therefore, de-industrialization would be a natural process hand-in-hand with development. It is assumed that as the level of income increases, there is a shift in consumption patterns from non-processed goods to manufactured goods (industrialization), and from manufactured goods to services (de-industrialization). Evidence of this assumption is found by Rowthorn and Ramaswamy (1997) and Kang and Lee (2011) in OECD countries, while Kaya (2010) finds some significant results in the case of developing countries. The existence of this relationship has been tested by considering the impact of the square of GDP per capita, with a predicted negative impact. To reduce potential heteroskedasticity issues, we use the square of the logarithm of GDP per capita (GDPCAP2). International trade can be an explanatory factor for industrialization: according to Rowthorn & Ramaswamy (1999), the trade surplus in manufactured goods is positively correlated to domestic manufacturing output and employment and can help finance a trade deficit in non-manufactured goods. Moreover, Rowthorn and Ramaswamy (1997) find that imports have a negative impact on industrialization, and Kaya (2010) finds that the impact of low technology exports on industrialization is positive. On the basis of these studies, we include exports (EXP) and imports (IMP) as a percentage of GDP at current prices. The predicted signs of these variables are unknown as on the one hand, international trade statistics show that African countries export

mainly commodities and import sizeable quantities of manufactured goods, including means of production, and on the other hand, exports and imports can be channels of technological spillovers, which can increase productivity and thus stimulate industrialization. Business activities in international markets increase enterprises' exposure to more advanced technologies or goods and allow firms to acquire technologies or imitate goods (Keller, 2010), as in the cases of China and India (Dahlman, 2009).

Because the expansion (contraction) of a sector corresponds to the contraction (expansion) of other sectors, the value added of the agricultural sector in percentage of GDP is included (AGRI). To include this variable, we have modified the model estimated by Kang & Lee (2011), who use the size of the service sector in OECD countries when analyzing de-industrialization and the emergence of the service sector. In fact, the present study analyzes African countries with significant contributions by the agricultural sector in some cases, and development is also about moving from low wage activities (agriculture, in this situation) to higher wage activities, such as jobs in manufacturing. It is worth noting that the size of the service sector could also have been considered in conjunction with the variable AGRI; however, considering those two variables in an econometric model is likely to create multi-colinearity issues.

The variable FDI corresponds to net total foreign direct investment inflows as a percentage of GDP (both variables in current prices) as suggested in Kang and Lee (2011) and Kaya (2010). This variable has some limitations because it integrates manufacturing and resource-seeking FDI inflows while this study is mainly concerned with the manufacturing sector. Unfortunately, data presenting the sectoral breakdown of FDI inflows received by African countries are not always available and cannot be used in a robust analysis.

4.2. Estimation strategy

The basic model is presented below:

$$INDU_{it} = \alpha X_{it} + \beta FDI_{it} + \varepsilon_{it} + region,$$

where the matrix X_{it} is made up of the following variables: GDPCAP, GDPCAP2, INV, EXP, IMP, and AGRI. The variable INDU represents the level of industrialization, or the valued added of the manufacturing sector as a percentage of GDP (at constant prices), ε_{it} represents the residual, and *region* stands for the dummy variables of the regions because they are at different levels.

Autocorrelation and heteroskedasticity tests performed on the basis of fixed effects and random effects models revealed that it was necessary to use the feasible generalized least squares method (FGLS) to estimate the coefficients (Pirotte, 2011; Greene, 2012). Because the form of autocorrelation is not known accurately, common AR (1) and panel-specific AR (1) are tested.

Based on the results from other studies related to the impact of FDI, we consider for robustness checking the role of the financial sector, the role of the government, and analyses by sub-period.

A causality test on panel data was performed to check the potential existence of reverse causality, here, INDU being caused by FDI (a determinant of FDI). On the basis of the Dumitrescu-Hurlin causality test (Dumitrescu & Hurlin, 2012), the absence of causality in this direction could not be rejected.

The literature review stresses the role of the public and financial sectors during many countries' industrialization processes. Government interventions are represented by sub-components of the economic freedom index produced by the Fraser Institute (Gwartney, Lawson, & Hall, 2012) as follows: government enterprises and investment (GOV), freedom to trade internationally (INT), and regulation (REG). Economic freedom indices range between zero and 10, with zero

indicating the highest level of government intervention. According to Gwartney, Lawson, & Hall (2012), GOV represents the importance of state owned enterprises in the economy, INT measures the magnitude of trade restriction barriers (tariff and non-tariff barriers), and REG measures the freedom to enter into a market. The role of the financial sector will be represented by its size (money supply as a percentage of GDP, M2). The analyses by sub-period are justified by the fact that when analyzing the same set of African countries over the period from 1980 to 2009, Gui-Diby (2014) finds that the impact of FDI on the economic growth is positive during the period from 1995 to 2009 and negative before this period.

4.3. Data

The dataset comprises yearly observations of 47 African countries during the period from 1980 to 2009. For each variable, approximately 1,410 observations will be used. Net FDI inflows were extracted from the United Nations Conference for Trade and Development (UNCTAD) database. Data on the value added of the manufacturing, service and agricultural sectors, gross fixed capital formation, exports, and imports as a percentage of GDP were obtained from the United Nations Statistics Division (UNSD) database for main national accounts aggregates. The shares of value added of the manufacturing and agricultural sectors were computed on the basis of country national accounts data estimated in US dollars at constant 2005 prices. The manufacturing sector corresponds to economic activities under the Section D of the International Standard Industrial Classification of All Economic Activities, Rev.3.1 (ISIC Rev 3.1)[21]. The Penn world tables were used for PPP GDP per capita at 2005 constant prices. The share of

[21] See http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=17 for details (accessed on December 20, 2014)

employment in the manufacturing sector is extracted from the International Labor Organization (ILO) KILM database, 8th edition. Data on government interventions and the standard deviation of prices were obtained from the Fraser Institute (Gwartney, Lawson, & Hall, 2012), while data on the size of the financial sector were extracted from the World Development Indicators (WDI) database of the World Bank.

Table 3.2 presents the correlation matrix between all the variables and shows that: (i) the correlation between the level of industrialization and the level of income seems to be weak; (ii) FDI inflows and national investments are negatively correlated to the level of industrialization; and (iii) the roles played by the government and the financial sector in the evolution of industrialization appear to be modest.

Table 3.2: Correlation matrix between all the variables of the study

Variables	INDU	AGRI	FDI	INV	EXP	IMP	M2	GDPCAP	GDPCAP2	GOV	REGU	INT
INDU	1.00											
AGRI	-0.12	1.00										
FDI	-0.16	-0.09	1.00									
INV	-0.10	-0.38	0.37	1.00								
EXP	0.05	-0.62	0.35	0.29	1.00							
IMP	0.07	-0.39	0.32	0.60	0.54	1.00						
M2	0.16	-0.45	0.00	0.22	0.19	0.27	1.00					
GDPCAP	0.06	-0.76	0.12	0.32	0.64	0.27	0.47	1.00				
GDPCAP2	0.05	-0.75	0.12	0.32	0.65	0.27	0.47	0.99	1.00			
GOV	0.19	-0.13	0.06	0.15	0.06	0.06	0.07	0.07	0.08	1.00		
REG	0.30	0.02	-0.03	0.22	-0.19	0.13	0.17	0.08	0.08	0.15	1.00	
INT	0.07	0.06	0.11	0.16	0.00	0.17	0.12	0.07	0.07	0.09	0.53	1.00

Sources: Authors' calculations based on various data sources.

Table 3.3 presents descriptive statistics for all the variables. On the basis of this table and by computing the coefficients of variation, it can be concluded that the variable FDI is the most scattered variable.

Table 3.3: Descriptive Statistics

Variables	Average	Standard Deviation	Minimum	Maximum	Observations
INDU	0.098	0.064	0.001	0.411	1470
AGRI	0.265	0.156	0.017	0.945	1470
FDI	0.029	0.074	-0.654	0.905	1470
INV	20.171	10.798	2.000	107.846	1470
IMP	40.729	25.269	1.868	178.714	1470
EXP	30.163	19.450	1.360	121.78	1470
GDPCAP	7.174	0.920	4.764	10.191	1470
GDPCAP2	52.306	13.874	22.697	103.862	1470
GOV	3.714	3.047	0	10	482
REG	5.771	1.043	2.8	8.2	482
INT	5.44	1.498	0	8.8	468

Sources: Authors' calculations based on various data sources.

5. Empirical results

Table 3.4 presents the results of regressions performed with all the countries during the period from 1980 to 2009. Columns (1) and (2) present results of the analysis performed by only considering the control variables and incorporating a common AR (1) and 49 panel-specific AR (1), respectively, in (1) and (2). Columns (3) and (4) incorporate the variable FDI inflows with the above mentioned forms of autocorrelation. Results in columns (5) through (9) present robustness analyses with the inclusion of: the financial sector and government intervention. Results by sub-period are reported in Appendix 3.2.

First, **the size of the market or the level of income** has a positive impact on industrialization because the sign of the coefficient associated with GDP per capita is positive. On the basis of the negative sign of the square of GDP per capita, it can be concluded that this impact increases up to a certain level and later decreases. Table 3.4 indicates that the turning point of de-industrialization is between $381 (column 2) and $472 (column 3). These turning-point results are well below those found by Rowthorn & Ramaswamy (1999) who find a turning point equal to at least $8,276, do not match with the inverted U theory on industrialization/de-industrialization which establishes the link between the size of the manufacturing sector and the level of income, and thus, should be mainly interpreted as an indication of an early decrease of the size of the manufacturing sector. With these relatively low levels of income and industrialization, we should expect an expansion of the manufacturing sector with the level of income level. Rodrik (2014)'s analyses concur with the fact that the contraction of the manufacturing sector occurs earlier in African countries than in advanced economies. This situation is likely linked to the implementation of structural adjustment programs in African countries, to the occurrence of a natural resource curse phenomenon over the period from 1980 to 1994, and to the increase of imports of manufactured final products (which constitute more than 50% of the total imports) over the period from 1995 to 2009 *(See the results on the impact of investments, exports, and imports)*. In fact, according to Stein (1992), sub-Saharan African countries faced an industrial crisis due to the significant expansion of the industrial sector led by import substitution industries and remarkably ineffective government interventions in productive activities. As a result, Stein (1992) argues that the World Bank/IMF prescriptions that were implemented through structural adjustment programs contributed to the destruction of the manufacturing base of African countries. Stein (1992, p.85) resumes these prescriptions in

resource shifts "*from industry to agriculture, from public to private ownership, import-substituting to export industries, and final good production to raw material processing […].*" As a consequence, manufacturing activities began declining or stopped increasing when African countries did not have high income levels and an entrepreneurial class could not emerge. In the case of African countries, results related to the inverted-U assumption show that de-industrialization occurred at an early stage, not at an advanced stage of development as suggested by this theory and results from advanced economies. For UNCTAD (2007), structural adjustment programs contributed to the restoration of macroeconomic stability but did not contribute to structural transformation and diversification, and thus to industrialization.

Table 3.4: Results of regressions with annual data (1980-2009) – Dependent variable: INDU

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
GDP per capita	0.05663***	0.05552***	0.05948***	0.05728***	0.05941***	0.05084***	0.12160***	0.11882***	0.12679***
	(4.47)	(4.75)	(4.64)	(4.98)	(4.34)	(4.15)	(4.70)	(5.17)	(6.11)
Investment	-0.00008**	-0.00011**	-0.00009**	-0.00012**	-0.00012**	-0.00017***	-0.00026*	-0.00029**	-0.00042***
	(-2.02)	(-2.51)	(-1.98)	(-2.75)	(-2.28)	(-3.65)	(-1.73)	(-2.21)	(-3.11)
Exports	-3.14e-05	-3.53e-05	-3.19e-05	-4.49e-05	-6.11e-05	-0.00009**	-0.00053***	-0.00040***	-0.00056***
	(-0.82)	(-1.03)	(-0.81)	(-1.35)	(-1.30)	(-2.55)	(-4.31)	(-3.29)	(-4.43)
Imports	0.00006**	4.92e-05	0.00006**	5.26e-05	7.24e-05	6.10e-05	0.00034***	0.00023**	0.00030***
	(2.23)	(1.67)	(2.20)	(1.87)	(1.86)	(1.80)	(2.99)	(2.12)	(2.81)
Agriculture	-0.09626***	-0.07811***	-0.09529***	-0.08052***	-0.08237***	-0.07206***	-0.12759***	-0.14370***	-0.15401***
	(-12.57)	(-11.67)	(-12.36)	(-11.92)	(-9.74)	(-9.47)	(-7.25)	(-8.81)	(-9.59)
GDPCAP2	-0.00461***	-0.00467***	-0.00483***	-0.00476***	-0.00478***	-0.00416***	-0.00916***	-0.00900***	-0.00930***
	(-5.33)	(-5.82)	(-5.54)	(-6.03)	(-5.15)	(-5.10)	(-5.16)	(-5.58)	(-6.45)
FDI			-0.00110	-0.00073	-0.00518	-0.00551	-0.00308	-0.00262	0.00589
			(-0.34)	(-0.20)	(-1.34)	(-1.36)	(-0.17)	(0.18)	(0.39)
Size financial sector (M2)					0.00009***	3.71e-05	0.00017**	0.00009	0.00008
					(2.74)	(1.19)	(2.34)	(1.15)	(1.09)
Government investment/SOE							0.0042		
							(1.57)		
Freedom to enter in market (REG)								-0.00004	
								(-0.05)	
Free internat. Trade (INT)									0.00044
									(0.83)
constant	-0.0640	-0.0512	-0.0729	-0.0612	-0.0798	-0.0496	0.26883***	-0.24524***	-0.28020***
	(-1.35)	(-1.18)	(-1.52)	(-1.43)	(-1.55)	(-1.06)	(-2.83)	(-2.94)	(-3.70)
Dummy region	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	1468	1468	1468	1468	1344	1344	470	467	447
Type of autocorrelation	Common	Panel-specific	Common	Panel-specific	Common	Panel-specific	Common	Common	Common
Turning point	$465	$381	$472	$410	$500	$451	$763	$735	$913

*, **, and *** refer to 10%, 5%, and 1% significance levels, respectively. Figures in brackets represent z-statistics.

Second, the impact of the variable **investment** seems to be significant and negative for all the estimated equations while the impact of trade variables differs by sub-period (see Appendix 3.2). Further, the coefficients associated with exports are negative during the period from 1980 to 1994 while those associated with imports are positive during the same period. The impact of imports on industrialization is negative during the period from 1995 to 2009. The negative coefficients observed with the variable **investments** do not match those found by Kang & Lee (2011), Rowthorn & Ramaswamy (1999), and Rowthorn & Ramaswamy (1997).

Coefficients associated with **exports** and **trade balance** match those found by Kang & Lee (2011) but differ from those found by Rowthorn & Ramaswamy (1999) and Rowthorn & Ramaswamy (1997), who use the trade of manufactured goods in advanced economies. The results of this study should be interpreted bearing in mind the following elements in the African context: exports have been largely made up of commodities (highly concentrated) while imports have been highly diversified, with a significant share of final good products.

The results on the negative impact of investment and exports can be explained by the natural resource endowment and its economic consequences, and by the sets of economic policies implemented by a sizeable number of African countries. These results correspond also to the occurrence of a natural resource curse phenomenon (for details, see Frankel, 2012) during the period from 1980 to 1994, but this phenomenon seems to have stopped over the period from 1995 to 2009. In terms of natural resource endowments, resource rich countries naturally expanded their natural resource related activities and were able to display a trade surplus. Thus, an explanation of the negative impact of investments and exports can be found in the fact that, according to Corden & Neary (1982) and Botta (2010), a boom in a specific sector (including the natural resources sector) can contribute to de-industrialization by attracting more resources and

investments than the manufacturing sector.[22] Thus, the attractiveness of the booming sector can be the root of a "role model" phenomenon (Brautigam, 2009; Crespo and Fontoura, 2007) because the first enterprises in the sector provide information on failures and successes to other potential investors. Recorded successes in the booming sector could have dragged more local investments in the sector (Lin, 2011). For instance, natural resources have been playing increasingly important economic roles in African countries: in 1980, 50% of African countries had natural resource rents equal at least to 6.3% of GDP, while in 2009, rents were equivalent to 10.5% of GDP. Further, it is shown by (Mendoza, 2010) that international trade determines the learning curve of local firms; the complexity of exports products would push local firm to learn more abroad. Concerning the economic policies, it should be stressed that African countries have been highly vulnerable to international shocks, which is among the factors that forced these countries to use the IMF and World Bank's financial facilities and later their structural adjustment programs.

Pertaining to **imports**, the positive impact during the period from 1980 to 1994 can be explained by the importation of capital or intermediate goods in the framework of import-substitution industrialization strategies (Stein, 1992, p. 84). The negative impact over the second period can be the result of the combination of two factors: deindustrialization due to structural adjustment programs that left countries with weak human capacities and a small industrial base (Stein, 1992; UNECA, 2011), and the import structure, which is highly diversified and thus may not have contributed to creating conditions for the emergence of a strong manufacturing sector. It is even argued that: "*[…] the growing dependence on imports eroded the weak industrial base of most*

[22] In this paper, while it seems that there is a Dutch-Disease in these countries during specific periods, we are not addressing this issue as it would have required analyzing another set of variables.

African countries" (UNECA, 2011, p. 15). Nevertheless, it must be noted that other conditions, such as a poor business environment, also contribute to the non-development of a strong manufacturing base (Rodrik, 2014). To conclude on the sign of the coefficients of trade variables, the likelihood of their sign is also confirmed by the negative sign of the coefficient associated with the variable *trade balance* (See Appendix 3.3); meaning that improving the trade balance would also have a negative impact on industrialization, as in Kang & Lee (2011).

Robustness analyses show that, apart from trade variables, coefficients associated with other control variables seem to consistently retain the same sign and, to a certain extent, the same level of significance. Moreover, evidence of the (positive) importance of the financial sector for industrialization is found in many equations, while there is no evidence of the impact of government intervention on industrialization. The results concerning the impact of the financial sector are similar to those presented by Da Rin & Hellman (2002). However, variables related to the intervention of governments do not have a significant impact on industrialization.

Finally, concerning **the impact of FDI**, most of the analyses show non-significant results, and if it did exist, the results reported in columns (5) and (7) in Appendix 3.2 show that this impact would have been negative. While the analysis of employment is not worth considering, its results show that the impact of FDI is not significant. These results match with the ones of Kaya (2010) in 64 developing countries but do not correspond to the ones of Kang & Lee (2011). Two reasons for the failure of FDI to contribute to industrialization could be government's ineffective interventions (see results in Table 3.4), and governments' failure to establish the enabling environment to attract FDI inflows in the manufacturing sector. Firstly, according to results in Table 3.4, government's interventions did not have a significant impact on industrialization. This result might be due to low variability of the explanatory variables. However, some studies, such

as Stein (1992), UNECA (2011), suggest that some African countries implemented unfriendly measures for industrialization such as: monopoly restrictions such as exclusive exploration rights, sole supplier contracts, and domestic-market exclusivity. These measures could not help strengthen the backward, forward or horizontal linkages that could have been established between MNCs and local enterprises. The evaluations, on the limited FDI spillover effects in African countries, which have been performed by Stein (1992) and UNECA (2011), are also supported by UNIDO (2013). Moreover, UNCTAD (2007) argues that governments failed to design and implement sound industrial policies because they lacked technical and analytical capabilities, and there was a poor management of public goods and services. Therefore, the negative impact of government interventions cannot be completely ruled out, even though it might be during specific periods which probably vary significantly according to the country. Secondly, pertaining to the government's failure to establish the required enabling environment, countries' business environment and governance indicators published by the World Bank show that African countries are lagging in this domain, thus impeding the development of a strong private sector, particularly the manufacturing sector.[23] For example, empirical studies performed by Asiedu (2006), Alsan, Bloom, and Canning, (2006), and Gui-Diby (2012) confirm that countries with sizeable endowments of natural resources received larger FDI inflows. Furthermore, according to Alsan, Bloom, and Canning, (2006), foreign investors have been attracted to developing countries with high levels of income (mainly resource rich countries) and high levels of corruption. UNIDO (2013, p. 116) also stresses that resource rich countries with low governance did not change structurally.

[23] See http://www.doingbusiness.org/

6. Conclusion and summary

This chapter examines the impact of FDI inflows on industrialization in African countries during the period of 1980 to 2009. The results indicate that FDI inflows did not have a significant impact on countries' industrialization. Our results remain robust to the insertion and alteration of different variables such as the size of the financial sector, trade balance and government interventions and to analyses performed by sub-period. This suggests that one reason for the failure of FDI to contribute to industrialization could be governments' failure to establish an enabling environment for FDI to catalyze industrialization. This situation resulted in hosting resource-seeking FDI inflows and the existence of weak or no links between MNCs and local enterprises.

These results should galvanize African policy makers to rethink the design of national policies aimed at attracting FDI, as well as to design and implement sound industrial policies and streamline both types of policies in the same framework. The coherence of both sets of policies will be critical to optimize the benefits that these countries and their people will be able to receive.

It should be noted, however, that this chapter is limited due to the unavailability of reliable data on employment in the manufacturing sector and of FDI breakdowns by sector for the time period considered. Moreover, by analyzing 47 countries in the same dataset, it is assumed that all countries intended to develop their countries through industrialization, which may not have actually been the case. Considering the country of origin of FDI inflows could have also provided interesting features, but this subject might consider for future research.

7. Appendices

Appendix 3.1: List of countries by sub-region

Region 1 =Eastern Africa	Region 2=Central Africa	Region 3= Northern Africa	Region 4= Southern Africa	Region 5= Western Africa
Burundi	Angola	Algeria	Botswana	Benin
Comoros	Cameroon	Egypt	Lesotho	Burkina Faso
Djibouti	Central African Republic	Morocco	Namibia	Cape Verde
Ethiopia	Chad	Sudan	Swaziland	Cote d'Ivoire
Kenya	Congo	Tunisia		Gambia
Madagascar	Dem. Rep. of Congo			Ghana
Malawi	Equatorial Guinea			Guinea
Mauritius	Gabon			Guinea-Bissau
Mozambique	Sao Tome and Principe			Liberia
Rwanda				Mali
Seychelles				Mauritania
Tanzania				Niger
Uganda				Nigeria
Zambia				Senegal
Zimbabwe				Sierra Leone
				Togo

Appendix 3.2: Results of regressions by sub-period with annual data – Dependent variable: INDU

Periods	**Period 1: 1980-1994**					**Period 2: 1995-2009**				
Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
GDP per capita	0.0979***	0.0863***	0.0604***	0.0562***	0.0274***	0.0923***	0.1640***	0.1359***	0.1445***	0.1223***
	(6.50)	(6.16)	(5.83)	(4.79)	(2.69)	(3.92)	(6.47)	(5.76)	(5.95)	(6.26)
Investment	-0.0003***	-0.0042***	-0.0006***	-0.0002**	-0.0005***	-0.0001	-0.0001	-5.2e-6	-0.0002	-0.0002*
	(-3.83)	(-4.18)	(-7.30)	(-2.41)	(-7.20)	(-0.99)	(-1.28)	(-0.53)	(-1.54)	(-1.72)
Exports	-0.0003**	-0.0002***	-0.0004***	-0.0003	-0.0003***	-0.0001	8.16e-6	1.1e-6	-8.1e-6	5.0e-6
	(-2.16)	(-2.60)	(-6.14)	(-0.39)	(-5.49)	(-1.08)	(0.09)	(0.14)	(0.86)	(0.64)
Imports	0.0002***	0.0003***	0.0002***	0.0001**	0.0002***	-0.0001*	-0.0002***	-0.0002***	-0.0002***	-0.0002***
	(3.75)	(3.80)	(4.26)	(2.46)	(4.33)	(-1.91)	(-3.01)	(-3.50)	(-2.88)	(-3.90)
Agriculture	-0.1095***	-0.1086***	-0.0735***	-0.0520***	-0.0616***	-0.1134***	-0.1163***	-0.0892***	-0.0924***	-0.0869***
	(-12.22)	(-10.74)	(-8.33)	(-5.24)	(-7.71)	(-9.75)	(-9.42)	(-8.37)	(-7.12)	(-7.70)
GDPCAP2	-0.0068***	-0.0062***	-0.0045***	-0.0044***	-0.0025***	-0.0071***	-0.0120***	-0.0100***	-0.0108***	-0.0096***
	(-6.56)	(-6.34)	(-6.49)	(-5.37)	(-3.74)	(-4.35)	(-6.86)	(-6.07)	(-6.63)	(-7.38)
region1				0.0132***	0.0133***				0.0122***	0.0070**
				(5.12)	(5.99)				(3.05)	(2.22)
region2				-0.0151***	-0.0172***				-0.0060	-0.0067*
				(-5.00)	(-6.44)				(-1.30)	(-1.85)
region3				0.0635***	0.0483***				0.0289***	0.0313***
				(9.75)	(6.48)				(4.71)	(5.00)
region4				0.0532***	0.0544***				0.0374***	0.0388***
				(5.01)	(4.15)				(4.12)	(4.62)
FDI	-0.0028	-0.0024	-0.0103	-0.0072	-0.0142**	-0.0064	-0.0205*	-0.0141	-0.0238*	-0.0178
	(-0.67)	(-0.41)	(-1.32)	(-1.34)	(-2.53)	(-0.57)	(-1.73)	(-1.21)	(-1.93)	(-1.43)
Size of financial sector (M2)		0.0002***	0.0005***	0.0001**	0.0003***		0.0003***	0.0002***	0.0002***	0.0001*
		(3.42)	(7.82)	(2.26)	(5.06)		(5.98)	(4.40)	(3.23)	(1.69)
constant	-0.2240***	-0.1782***	-0.0927	-0.0848*	0.0251	-0.1660*	-0.4284***	-0.3299***	-0.3626*	-0.2577***
	(-4.03)	(-3.47)	(-2.35)	(-1.95)	(0.63)	(-1.96)	(-4.67)	(-3.92)	(-3.98)	(-3.50)
Number of observations	733	703	703	703	703	735	641	641	703	641
Type of autocorrelation	Common	Common	Panel-specific	Common	Panel-specific	Common	Common	Panel-specific	Common	Panel-specific

*, **, and *** refer respectively to 10%, 5%, and 1% significance level. Figures in brackets represent z-statistics (Normal density).

Appendix 3.3: Results of regressions with trade balance – Dependent variable: INDU

Periods	**1980-2009**		**1980-1994**		**1995-2009**	
Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
GDP per capita	0.0592*** (4.33)	0.0521*** (4.15)	0.1478*** (6.08)	0.1249*** (6.36)	0.0497*** (4.36)	0.0397*** (3.70)
Investment	-0.0001** (-2.27)	-0.0002*** (-4.20)	-0.0002* (-1.89)	-0.0002** (-2.37)	-0.0001** (-1.86)	-0.0004*** (-6.46)
Trade balance	-0.0001* (-1.91)	-0.0001*** (-2.70)	0.0001** (2.46)	0.0002 (2.89)	-0.0001** (-2.25)	-0.0002*** (-3.88)
Agriculture	-0.0828*** (-9.95)	-0.0744*** (-9.87)	-0.0886*** (-7.05)	-0.0803*** (-7.37)	-0.0541*** (-5.49)	-0.0639*** (-7.52)
GDPCAP2	-0.0048*** (-5.16)	-0.0043*** (-5.05)	-0.0111*** (-6.78)	-0.0098** (-7.51)	-0.0039*** (-4.89)	-0.0034*** (-4.79)
FDI	-0.0050 (-1.31)	-0.0060 (-1.57)	-0.0252** (-1.99)	-0.0186 (-1.44)	-0.0061 (-2.53)	-0.0137*** (-2.77)
Size of financial sector (M2)	0.0001*** (2.74)	4.2e-5 (1.36)	0.0002*** (3.24)	0.0001* (1.75)	7.5e-5 (1.52)	0.0002*** (3.07)
Region dummy	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	1344	1344	641	641	703	703
Type of autocorrelation	Common	Panel-specific	Common	Panel-specific	Common	Panel-specific

*, **, and *** refer respectively to 10%, 5%, and 1% significance level. Figures in brackets represent z-statistics (Normal density).

Appendix 3.4: Results of regressions – Dependent variable: Employment in manufacturing sector

Variables	**(1)**	**(2)**	**(3)**
GDP per capita	8.18 (0.66)	11.64 (0.97)	9.35 (0.92)
Investment	-0.17 (-1.38)	-0.15 (-1.26)	-0.02 (-0.28)
Exports	0.09 (1.04)	0.10 (1.19)	0.24*** (3.74)
Imports	0.07 (1.53)	0.07 (1.56)	0.004 (0.17)
Agriculture	-0.22*** (-9.75)	-0.23*** (-9.97)	-0.15*** (-7.30)
GDPCAP2	-0.61 (-0.71)	-0.85 (-1.02)	-0.85 (-1.25)
FDI		-37.44 (-1.39)	-43.35* (-1.82)
Size of financial sector (M2)			0.12 (6.48)
Number of observations	71	71	71

*, **, and *** refer respectively to 10%, 5%, and 1% significance level. Figures in brackets represent t-statistics (t-Student). Results are based on pooled ordinary least squares (OLS) because the panel is highly unbalanced.

Chapter 3: Foreign Direct Investment Flows and Technological Transfer: The Case of Kenya

1. Introduction

African countries recorded robust economic growth rates over the recent years, and the expansion of these economies has been mainly driven by the production and the exportation of commodities (UNECA, 2013). Thus, this growth has not been translated into a radical transformation of these economies because the manufacturing sector, which can create many jobs, still plays a marginal role. To reduce the volatility of the economic expansion and to make it more sustainable and to move towards more diversified economies, African countries would need technology and would be required to increase substantially their innovative capacities. However, according to UNECA (2014), "Africa's global share of knowledge generation and ownership remains low." This means that African countries need to rely on heavily used channels of international technological transfer, including exports, imports, and foreign direct investment (FDI) inflows.

Although acknowledging that all of the above mentioned channels could be important, the actual paper focuses only on FDI inflows (i) because the motives of foreign investments occurring in Africa seem to have slightly changed during the recent years with more market-seeking investments (UNECA, 2013) and (ii) because during the period from 1980 to 2009, FDI inflows had a significant and positive impact on the economic expansion of African countries, but this impact was not constrained by the availability of a skilled labor force (See **Chapter 1**); however, (iii) FDI inflows were not able to contribute to the industrialization of African countries (**see Chapter 2**). Moreover, Kemeny (2010) finds that FDI contributed to the technological upgrading of several economies, particularly the ones with higher social capabilities such as higher

technical competence, lower political risks and good governance (for details on this variable, see Kemeny, 2010, p. 1547), whereas Jin, Lee, & Kim (2008) show that innovation is playing an increasing role as a driver of economic growth in China. Thus, analyzing the impact of FDI inflows on technological transfer could help in drawing some policies aiming at maximizing the benefits from this type of inflow.

In this area of research, to our knowledge, only a few empirical studies have been performed to tackle this issue in the case of African countries, and we can cite the following: Farole & Winkler (2014), Waldkirch & Ofosu (2010), and Bwalya (2006). Bwalya (2006) and Waldkirch & Ofosu (2010) perform country analyses on the basis of Zambian and Ghanaian firms, respectively. Farole & Winkler (2014) perform analyses on African countries and also include Vietnam and Chile as benchmark countries in the analysis. These authors use the most recent survey data and try to explain technological transfers by analyzing the impact of foreign direct investment on the productivity of firms. However, the estimation of productivity requires using specific econometric methods such as those proposed by Olley & Pakes (1996) and Levinsohn & Petrin (2003), and Farole & Winkler (2014) do not use this estimation strategy. Because we understand that Farole & Winkler (2014) face data constraints in the cases of African countries, this paper attempts to analyze technological transfer on the basis of a dependent variable that is not derived from an econometric method such as the ones mentioned above but is instead derived on the basis of a variable obtained from direct answer to a question related to the occurrence of innovation during a reference period. Moreover, this study contributes to the literature by only analyzing the occurrence of horizontal spillovers, and it uses a two-step approach that considers the issue of selection of firms by multinational enterprises. The chapter focuses specifically on

Kenya because its manufacturing sector accounts for more than 10% of the GDP, it exports manufactured products in several neighboring countries, and its economy is relatively diversified compared to other African economies.

The remainder of the chapter is organized as follows: Section 2 explains how FDI inflows can contribute to technological transfer and presents the relevant review of the literature; Section 3 presents the specification of the model and the empirical strategy and addresses data issues; Section 4 presents an overview of the status of innovation and foreign investments on the basis of survey data; Section 5 presents the empirical results and their interpretation; and Section 6 concludes and summarizes the results from the study.

2. Review of the literature

Several theoretical models have been proposed to explain the transfer of technology resulting from the entry of FDI inflows. Among others, we can cite the following contributions: Bertschek (1995) explains process and product innovation by imports and FDI in a domestic market characterized by monopolistic competition and finds that an increasing presence of foreign firms could increase both types of innovation through a decrease in prices; Vishwasrao & Bosshardt (2001) analyze the adoption of innovations introduced by foreign firms and find that foreign-owned firms are more likely to adopt technologies because they have lower initial costs of adoption and lower capital costs compared with domestic firms; and Guadalupe, Kuzmina, & Thomas (2012) analyze the impact of foreign ownership on innovation and consider the initial productivity of the foreign invested enterprises as an important determinant of this impact.

In general, theoretically, there seems to be a consensus on the potential role of FDI inflows in connection with technological transfer, but empirically, the level of the analysis (firm, industry, region, country) and the measures of technological transfer can determine the identification of the technological transfer phenomenon. The likelihood of the positive impact of FDI inflows can be analyzed by considering studies that analyze the impact of FDI inflows on foreign invested enterprises (FIEs), whereas studies that analyze horizontal or vertical spillovers provide another picture of technological transfer at the industry level.[24] In addition to these levels of analyses, the existence of different measurements of the technological transfer is also an important issue that can sometimes explain the diverging conclusions of authors in their empirical studies. Empirical results vary significantly according to the measure of technological transfer that is used. International technological transfer is measured by explaining a measure of technology with a set of control variables and a measure of the foreign presence. Concerning the measure of technology, several authors, including Bertschek (1995), Keller (2004), and Guadalupe, Kuzmina, & Thomas (2012), identify or use the following measures of technology: research and development (R&D) expenditures, the number of patents, the occurrence of a process or product innovation, the share of output resulting from new products or processes, or the productivity of the firm.

[24] Foreign invested enterprises (FIEs) are defined as enterprises with a minimum of 10% of foreign participation in their capital.

2.1. Impact on foreign invested enterprises (FIEs)

Pertaining to the impact of FDI inflows on foreign-invested enterprises, there are divergent results between studies based on innovation-related variables, whereas studies aiming at analyzing technological transfer on the basis of the productivity of the firm seem to mainly conclude that the productivity increases, particularly in countries with low levels of technology. The positive impact of FDI inflows on innovation-related variables in the case of acquired firms can be explained by the access to new technologies brought by foreign investors (Wang & Kafouros, 2009), and the provision of fresh capital, which increases the borrowing capacities of the firm, reduces financial constraints to access credit, and can unleash the potential of the firm to perform R&D activities (Girma, Gong, & Görg, 2008; Harrison & McMillan, 2003). Beyond technological reasons and the reasons related to the cost of investment, which is likely to be lower if the MNE (which is investing) has different R&D activities located around the world, market access benefits due to the entry of the foreign firm can be an important determinant because market access provides market scale effects (Guadalupe, Kuzmina, & Thomas, 2012; Vishwasrao & Bosshardt, 2001). However, a negative impact on innovation-related variables can be found, such as in the case of García, Jin, & Salomon (2013), who find a negative impact of FDI inflows on ex-post patent applications in the case of Spanish manufacturing firms observed from 1990 to 2002. This result could be related to the fact that foreign entrants had transferred the innovation activity from their affiliates to the headquarters. Such behavior would be the result of a necessity for the foreign entrant to keep its technological advantage over domestic firms (De Faria & Sofka, 2010; Martin & Salomon, 2003).

In terms of productivity, the impact of the entry of foreign capital on the productivity of the acquired firm is mostly positive in countries with relatively low technological levels, such as in the results of the following selected studies: García, Jin, & Salomon (2013) and Damijan & Knell (2005) examine the cases of Estonia and Slovenia during the periods from 1995 to 1999 and from 1994 to 1999, respectively; Dimelis & Louri (2004) analyze 3,742 Greek manufacturing firms in 1997; Damijan et al. (2003) consider the Czech Republic, Estonia, Poland, Romania and Slovenia; and Hu and Jefferson (2002) perform an analysis of Chinese firms in 1995 and 1999. In more technologically advanced countries, the impact may be nil, according to van Pottelsberghe de la Porterie & Lichtenberg (2001) who analyze United States, Japan and 11 European industrialized countries during the period from 1971 to 1990. van Pottelsberghe de la Porterie & Lichtenberg (2001) explain this result by the primary objective of this type of investment (strategic asset-seeking FDI), which is to exploit the technology available in the host country (Narula & Dunning, 2010; Dunning, 1994).

In conclusion, the impact of FDI on technological transfer in FIE will highly depend on the objective of the foreign investors when making the decision and on the fact that, according to Guadalupe, Kuzmina, & Thomas (2012), foreign investors generally select the most productive firms.

2.2. Horizontal and vertical spillovers

The entry of a multinational enterprise can result in technological transfer in the same industry through demonstration effects (imitation or reverse engineering) or the mobility of workers (Smeets, 2008). Although vertical spillovers can also be the result

of the mobility of workers, they are mainly related to the existence of supplier-buyer relations between MNE and local enterprises. The results of studies on the sign and magnitude of the above mentioned spillovers effects are mixed, specifically when considering horizontal spillovers and backward versus forward linkages in the case of vertical spillovers. For instance, regarding horizontal spillovers, Aitken & Harrison (1999) do not find strong evidence of horizontal spillovers in the case of Venezuelan firms, as with Damijan, Knell, Majcen, & Rojec (2003) in the case of eight transition economies; Waldkirch & Ofosu (2010) find a negative impact on the productivity of Ghanaian firms as a result of the entry of Chinese firms, and Keller & Yeaples (2009) as well as Liu (2002) find positive horizontal spillovers for firms in the United States and in China, respectively. Concerning vertical spillovers, Xu & Sheng (2012) find positive forward spillovers and negative backward spillovers in the case of Chinese manufacturing firms observed during the period from 2000 to 2003, Javorcik (2004) finds positive backward linkages in the case of Lithuania, and Bitzer, Geishecker, & Görg (2008) find positive spillovers through backward linkages but no evidence of forward linkages in OECD and Central and Eastern European countries.

Although the divergence of results can be explained by the usage of different dependent variables as mentioned above, different determining conditions of the impact of MNEs exist, such as the following: the absorptive capacities of the local firms, the structure of the ownership of the MNE, the country of origin of FDI inflows, financial constraints, the motives of the foreign investors, the proximity between the local firms and the

MNEs, and the intellectual property right framework of the host country of FDI inflows.[25]

Absorptive capacities

On the basis of data on state-owned enterprises (SOEs) observed from 1999 to 2005, Girma, Gong, & Görg (2008) find that the negative impact of FDI, which is observed in the sector of SOEs, is less important for firms with higher absorptive capacities, i.e., firms with more research & development expenditures, more labor training expenditures and greater export-orientation because exports also constitute a means of technological transfer. However, the general impact of FDI inflows on SOE productivity is negative because there might be many poor performing firms, which Girma, Gong, & Görg (2008) call "laggards" and which are adversely affected by competition and face a discouragement in innovating. The resulting importance of absorptive capacities is also confirmed by Girma (2005), who performs a threshold regression analysis with data on the UK manufacturing industry observed during the period from 1989 to 1999 and finds that (i) below a certain level of absorptive capacities, the FDI productivity spillovers are insignificant or negative and (ii) as the level of absorptive capacities increases, the marginal effect of FDI on productivity decreases.

Brambilla, Hale, & Long (2009) provide evidence, on the basis of Chinese domestic manufacturing firms, on the fact that medium-size firms will mostly benefit from the

[25] For the relationship between FDI and the intellectual property right environment, the reader can refer to Jiang *et al.* (2011) and Glass & Saggi (2002).

presence of MNEs because they can easily increase their profit by imitating MNEs; this means that instead of assisting the emergence of purely new products from domestic firms, we will assist the upgrading of their existing products through imitation in the objective of competing against MNEs. In addition to the level of absorptive capacity of the firm, the level of absorptive capacities of the region as well as the level of technological opportunities of the industry may determine the magnitude of FDI spillover effects, according to Fu (2008) and Wang & Kafouros (2009), respectively. Fu (2008) explains that beyond the availability of a skilled labor force and R&D activity, the dynamism of the entrepreneurial force, the availability of information and communication infrastructures and the existence of clusters of high-technology may increase the probability of innovations due to the assimilation of new ideas and technologies that are the results of internal research or external exchanges.

Share of the foreign participation in the MNE, country of origin of FDI, and motives

The share of the foreign participation in a MNE and the country of origin of FDI can have an impact on the likelihood of technological transfer because of the following reasons: FDI inflows from different countries are associated with different levels of technology and different motives for investment (Crespo & Fontoura, 2007), the ownership structure can have an impact on the level of technological transfer to the subsidiary because the MNE fears leakages (Takii, 2011; Müller & Schnitzer, 2006), and the level of participation of foreign investors can define the dynamic of exchanges with domestic firms (Javorcik & Spatareanu, 2008) – for instance, because of the

existence of preferential trade agreements or the cost of transport or communication between the host and the home countries (Javorcik, Saggi, & Spatareanu, 2004).[26]

Concerning horizontal spillovers, on the basis of an equation explaining total factor productivity, Lin, Liu, & Zhang (2009) find a negative impact of the entry of firms from Hong Kong, Macao and Taiwan (HMT) on Chinese firms because they tend to produce goods that are close substitutes of products from domestic firms (negative competition effect), whereas the impact of non-HMT firms is positive. These results of Lin, Liu, & Zhang (2009) on the total factor productivity are not significantly different from the results of Ito *et al.* (2012), but Ito *et al.* (2012) also find that the number of intra-industry patents increases as a result of the horizontal spillovers. It may be conjectured that competition effects are important and firms are creating "new" products to acquire market shares. Concerning the vertical technological spillovers, Javorcik & Spatareanu (2008) find a positive significant impact of joint ventures firms and a non-significant impact for fully owned firms in the case of Romanian firms, whereas Javorcik, Saggi, & Spatareanu (2004) show that American and Asian MNEs create positive spillovers in the downstream industry and European firms had a negative impact on downstream firms.

Regarding the motives of FDI, Lin, Liu, & Zhang (2009) find that vertical spillovers from export-oriented firms are less important than the vertical spillovers of market-seeking FDI. The authors explain this by the fact that vertical linkages exist outside China, and this competitive situation reduces the interaction with Chinese suppliers and

[26] Blomström & Sjöholm (1999) find opposite results in the case of Indonesia, with foreign ownership not being a determinant factor of technological spillovers, and Dimelis & Louri (2002) show that the size of the foreign ownership and the level of productivity of local firms are determinants of technological spillovers.

customers; as a result, the magnitude of vertical spillovers in China for export-oriented FDI is reduced. In fact, the strength of the linkages between domestic firms and MNE is an important factor that can determine the magnitude of the spillovers according to the theoretical frameworks developed by Rodríguez-Clare (1996) and Markusen & Venables (1999).

Spatial proximity

With reference to the spatial proximity of activities around MNEs, it is argued that spillovers are more important in regions hosting FDI because of the following: a low mobility of workers can be an impediment to technological transfer (Halpern & Muraközy, 2007, p. 786); it may be easier to transfer "tacit" knowledge through face-to-face exchanges (Fu, 2008, p. 90); and the concentration of firms allows a reduction of transportation costs or access to a skilled labor force at an "acceptable" level of wages for producing firms on the basis of the models developed, respectively, by Krugman (1991) and Krugman & Venables (1995) – these latter facts contribute to the strengthening of the potential positive forward and backward linkages.

The intensity of productivity spillovers is more important in the region hosting FDI, according to the findings of Girma (2005) in the UK manufacturing industry, observed between 1989 and 1999. In the analyses performed on Portuguese firms, Crespo, Fontoura, & Proença (2009) obtain similar results, with the difference that there are negative horizontal spillovers in the region but positive horizontal spillovers at the national level, and regarding vertical spillovers, there are positive backward spillovers

in the region but non-significant vertical spillovers at the national level. Crespo, Fontoura, & Proença (2009) explain that the dichotomy of results for horizontal spillovers is explained by short-term negative effects on the regional economy and long-term positive effects due to an improvement in the allocation and the usage of resources by domestic firms. Unlike Crespo, Fontoura, & Proença (2009), Halpern & Muraközy (2007) find positive horizontal spillovers in the case of domestic Hungarian manufacturing firms and also that these effects decrease when the distance to the MNE increases.

The results of the above-mentioned studies show that the occurrence and the identification of FDI spillovers depend on many factors, including the estimation strategy. Moreover, to our knowledge, few studies have been performed on African countries, apart from the following studies, among others: Waldkirch & Ofosu (2010) and Görg & Strobl (2005) with Ghanaian firms and Bwalya (2006) with Zambian firms. We intend to fill this gap by analyzing the impact of technological transfer on the Kenyan economy and by improving the estimation strategy, which includes a selection equation embedded in a two-step approach.

3. Specification of the model, estimation strategy and data issues

3.1. Specification of the model

Dependent variables

Our objective is to analyze international technological transfer in African countries, and several variables can be used as a dependent variable according to Bertschek (1995), Keller (2004), Wang & Kafouros (2009), and Guadalupe, Kuzmina, & Thomas (2012). These measures of technology are as follows: research and development (R&D) expenditures, the number of patents, the occurrence of a process or product innovation, the share of output resulting from new products or processes, or the productivity of the firm. Although these measures differ because they can be input, output, or performance variables, we choose to use a dummy variable (*ID*) taking the value one if the firm introduced a new product over a reference period (between one and three years) and zero otherwise. Because process innovation also exists, we consider the same type of questions for this type of innovation to derive a dummy variable (*IC*) for process innovation. The choice of these variables is mainly justified by data availability issues. Moreover, this type of question provided information on the degree of innovativeness over a reference period, whereas a performance indicator, such as the share of output due to innovation, may also integrate cyclical issues. Furthermore, it is not possible to use productivity data because productivity is estimated on the basis of specific methods

such as the methods proposed by Olley & Pakes (1996) or Levinsohn & Petrin (2003), and these methods require using panel data observed during a significant time period. However, the World Bank data cannot satisfy these conditions because enterprise surveys are not recurrent and have been organized mostly over the last years (2007 and 2013 in the case of Kenya).

Independent variables

As in the above-mentioned studies, we take the approach of using a set of control variables of innovation. On the basis of the studies performed by Mate-Sanchez-Val & Harris (2014), Murovec & Prodan (2009) and Avermaete *et al.* (2004), these variables can be classified into three categories of determinants: internal factors, market factors, and factors related to supporting entities. Internal factors are related to the firm's own characteristics and are as follows: firm size, firm age, years of experience of the manager in the sector, proportion of the skilled labor force, training of the labor force, and occurrence of R&D activities. Table 4.1 presents an overview of the usage of different control variables and the potential expected signs. Market factors are related to the exchanges between the firm and external entities while producing or selling its products and refer to the importance of exchanges with customers or suppliers in the development of innovation products or processes and the importance of sales on international markets (exports).[27] Although different supporting entities exist, the only two supporting entities that are considered in our study are the provision of subsidies by

[27] However, data on the exchanges with customers and suppliers during the development of an innovation are not available.

the government and the proportion of purchased fixed assets that are financed outside the financial system. [28]

Table 4.1: Synthesis of the determinants of product innovation and process innovation

Variables	Expected impact on innovation	Selected studies that use the same type of variable
Firm size (SIZ)	+/-	Hansen (1992), Bertschek (1995), Rammer, Czarnitzki, & Spielkamp (2009)
Years of experience of manager (YEA)	+	Avermaete et *al.* (2004), Koellinger (2008), Romero & Martínez-Román (2012)
R&D activities (RD)	+	Murovec & Prodan (2009), Raymond & St-Pierre (2010), Pellegrino, Piva, & Vivarelli (2012), Cuerva, Triguero-Cano, & Córcoles (2013)
Skilled labor force (SKL)	+	Furman, Porter, & Stern (2002), Avermaete *et al.* (2004), Liu, Hodgkinson, & Chuang (2014)
Training of labor force (TRL)	+	Furman, Porter, & Stern (2002), Avermaete *et al.* (2004), Liu, Hodgkinson, & Chuang (2014)
Exports (EXP)	+	Becker & Dietz (2004), Sun & Du (2010), Pellegrino, Piva, & Vivarelli (2012)
Assets purchased without bank funds (FIN)	-	Buesa, Heijis, & Baumert (2010), Pellegrino, Piva, & Vivarelli (2012), Cuerva, Triguero-Cano, & Córcoles (2013), Mate-Sanchez-Val & Harris (2014)

Concerning the measurement of the foreign presence, two types of variables are used: the percentage of foreign capital in a firm (firm level presence) and a derived variable representing the importance of MNEs in an industry (industry level presence). At the firm level, although a dummy variable representing the fact that the percentage of foreign capital is above 10% or not could have been used as the criterion defining FDI, it was thought that foreign investors are less likely to perform portfolio investments in African countries because legal systems are weak and it would be more profitable for them to have a significant control over the acquired firm to maximize their benefits and

[28] Data on government subsidies are not available.

minimize operational risks. At the industry level, the available data allows us to only check the occurrence of horizontal spillovers. To check the robustness of our results, we consider two variables that are related to "foreign activity" (Keller, 2004, p. 759) and are similar to the ones used by Brambilla, Hale, & Long (2009) [Equation 1] and Aitken & Harrison (1999) [Equation 2], respectively:

$$FS_j = \frac{\sum_i FS_{ij}}{S_{.j}} = \frac{\sum_i FS_{ij}}{\sum_i (FS_{ij} + \overline{FS_{ij}})} \quad (1)$$

$$FO_j = \frac{\sum_i FO_{ij}.Emp_{ij}}{Emp_{.j}} \quad (2)$$

where FS_{ij}, FO_{ij}, and Emp_{ij} represent respectively the total output of multinational enterprises (with foreign participation above 10%), the percentage of capital owned by foreign investors, and the number of employees of a firm *i* in the industry *j* respectively. FS_j represents the share of foreign firms in the total output of the industry *j*, and FO_j is the weighted average of foreign ownership share in the industry *j*, with the size of each firm as the weight.

Even though the realization of FDI technological transfer may take some time to happen, the unavailability of long time series obliges us to use static models such as the ones used by Wang & Kafouros (2009) and Dimelis & Louri (2002). Finally, industry-based dummy variables are used to control for specific heterogeneity.

3.2. Estimation strategy

Because the dependent variable is a dummy one, ordinary least squares (OLS) estimators would be biased, according to Bourbonnais (2005). Thus, the most appropriate type of model is from the class of binary models: a logit model or a probit model. Similar to Bertschek (1995) and Guadalupe, Kuzmina, & Thomas (2012), we use probit models to perform our analyses.

However, it is likely that selection biases exist because MNEs generally acquire the most productive local firms (Damijan & Knell, 2005; Guadalupe, Kuzmina, & Thomas, 2012). Damijan & Knell (2005) and Guadalupe, Kuzmina, & Thomas (2012) correct this type of bias by using approaches similar to the Heckman two-step model. In summary, the authors determine the probability of acquisition of a local firm by a foreign firm on the basis of a selection equation and use the subsequent firm-level probabilities to reweight each firm. To estimate the probability of selection, we use the variables that are used by Damijan & Knell (2005) and Guadalupe, Kuzmina, & Thomas (2012) or are similar to the variables they use and that can be derived on the basis of the questionnaire: size of the firm, capital intensity (assets per employee), labor cost per employee, the share of exports in total sales, and industries dummies.

For all of the equations that are estimated, we use the most recent available data because the World Bank Group could not follow all of the enterprises through the years. We perform three types of analyses: one set of analyses on all firms in the manufacturing sector, another set of analyses on 100% domestic firms of the sample, and a final set of analyses on foreign invested enterprises (FIEs). The above two-step approach is used for the overall sample. The samples exclusively composed of FIEs and domestic firms

allow us to analyze the impact of FDI on FIEs and the impact of foreign presence in an industry on local domestic firms, respectively. As found by Kafouros *et al.* (2008), exporting firms are more likely to innovate; we use this criterion to cluster our sample and sub-samples and to perform robustness analyses. We use the above mentioned indicators of foreign presence to check that results are not too sensitive to the *proxy* variable being used.

3.3. Data

We use data that have been collected by the World Bank Enterprise Surveys team. Survey data from Kenya are used and are available in 2013 and 2007. The surveys were conducted during the implementation of the Africa Enterprise Surveys initiative, and they use stratified random sampling methods for enterprises in the non-agricultural sector. The criteria used for the stratification are the following: industry, establishment size and region. Only 150 firms were identified in both rounds of surveys, whereas more than 600 firms were interviewed. Because our research is linked to FDI and technological transfer to support industrialization, we focus our analyses only on firms in the manufacturing sector. However, all of the variables used in the 2013 survey are not available in the 2007 survey. Thus, we have been obliged to focus our analysis on the most recent survey data. The definition of each variable is provided in appendix 1.

4. Descriptive analyses of the sample

To have an advanced signal on the potential correlation between variables, we perform chi square tests of independence for all of the qualitative variables that have been proposed. Table 4.2 presents the results of these statistical tests: the empirical chi square statistic and the p-value of the test. From these preliminary analyses, the following conclusions can be drawn:

- Product and process innovations are not independent;
- It is likely that the relationships between R&D activities, training of labor force and export, and product innovation as well as process innovation, are statistically significant; and
- The variables size of the firm, R&D activities, training of labor force and exports are not independent from being a MNC.

Table 4.2: Results of the Chi Square Tests on Independence

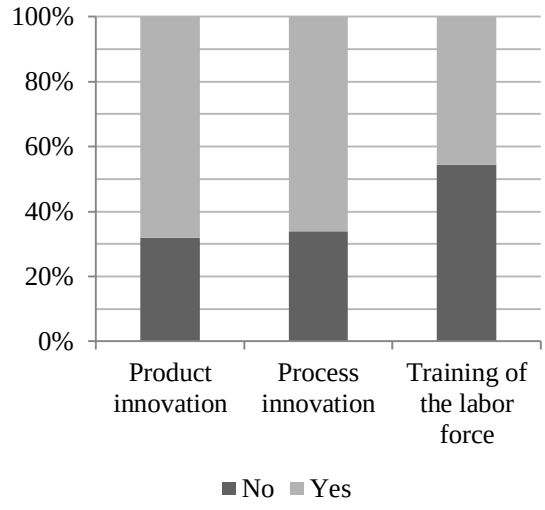
	Product innovation	Process innovation	FDI(1)	Size of the firm(2)	Industry	R&D	Training of labor
Process innovation	116.81*** (0.00)						
FDI	0.04 (0.85)	0.133 (0.72)					
Size of the firm	1.75 (0.42)	3.92 (0.14)	13.49*** (0.00)				
Industry	10.76 (0.87)	17.45 (0.42)	36.02** (0.01)	72.08*** (0.00)			
R&D	41.41*** (0.00)	30.00*** (0.00)	3.13* (0.08)	10.00** (0.01)	25.86* (0.08)		
Training of labor	15.86*** (0.00)	10.23*** (0.00)	12.19*** (0.00)	7.03** (0.03)	18.95 (0.33)	47.58*** (0.00)	
Dummy exports(1)	3.10* (0.08)	3.51* (0.06)	5.28** (0.02)	44.09*** (0.00)	26.32* (0.07)	23.34*** (0.00)	27.73*** (0.00)

Notes: *, **, and *** refer to 10%, 5%, and 1% significance levels, respectively. Figures in brackets represent p-values and figures above represent computed chi square statistics. (1) For the variables FDI and dummy exports, they have been created on the basis of 10% threshold. For instance, if the size of foreign ownership in a firm is equal or above 10%, the variable FDI is equal to one, zero else. (2) The variable "size of the firm" has been categorized with the following modalities: "small" for size above or equal to five and strictly below 20; "medium" for size above or equal 20 and below 100; and "large" for size above or equal to 100.

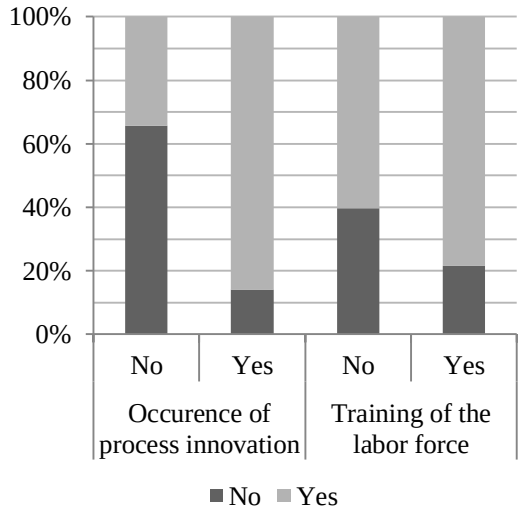
Pertaining specifically to the occurrence of innovation activities, Figure 4.1A shows that more than half of the firms have product innovation and another half has process innovation, whereas almost 55% of the firms do not have training programs for their staff. More precisely, approximately 56% of the firms simultaneously had product and process innovations over the past three years, whereas approximately 21% had only one of these types of innovation or more than 70% of the firms that have process innovation also have product innovation (Figure 4.1B). These statistics shed some light on the rejection of the hypothesis of independence between the two variables that was recorded with the chi square test. Furthermore, concerning the training of staff, although only 45% of the firms have training programs for their staff, almost 80% of the firms have product innovations (Figure 4.1B).

Figure 4.1: Analyses of the occurrence of product innovation, process innovation and training of the labor force (in %)

4.1A: Distribution of firms in the three categorical variables

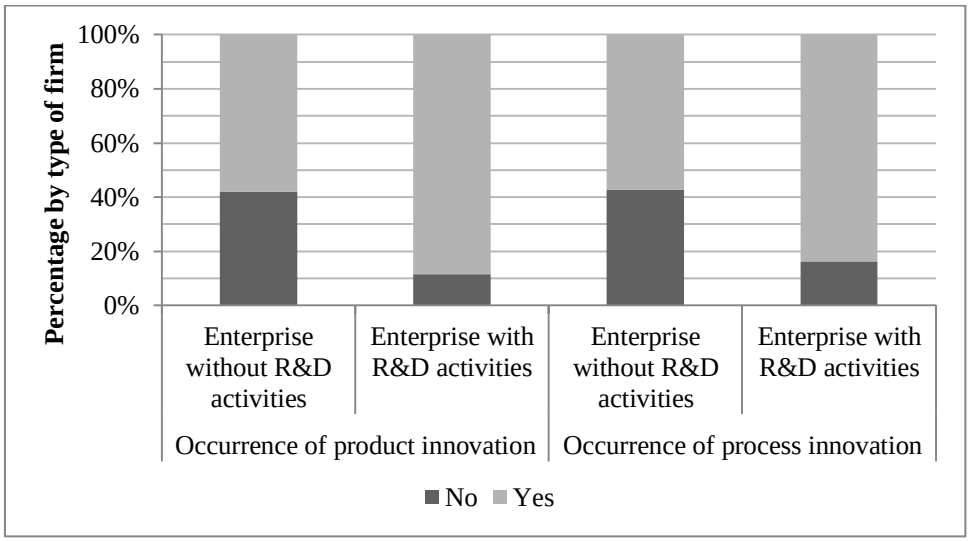


4.1B: Status of product innovation according to the occurrence of process innovation and the training of the labor force



Pertaining to the performance of R&D activities, although less than half of the firms (45%) have R&D activities, it seems that these activities have final results for these firms but that enterprises without "defined" R&D activities are also able to innovate; almost 60% of them have product innovation or process innovation (see Figure 4.2).

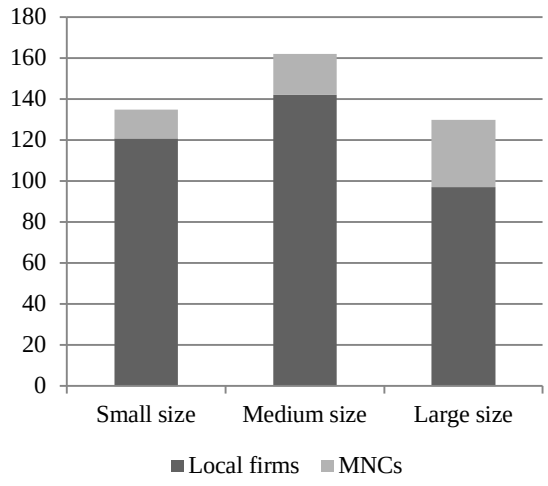
Figure 4.2: Analyses of the occurrence of innovations according to the existence of R&D activities (in %)



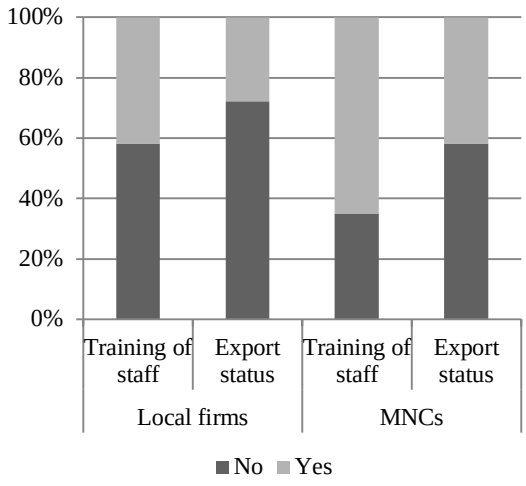
The sample is mainly composed of local firms, particularly small and medium enterprises (SMEs). MNCs are mainly large firms, but a few of them are also SMEs. Concerning the training of staff and the exportation of at least 10% of their products, a sizeable proportion of MNCs train their staff and are engaged in exporting activities while it is not the case for local firms (See Figure 4.3).

Figure 4.3: Distribution of firms according to their size, the foreign participation, the training of staff and their export status

4.3A: Distribution of firms according to their size and the category of firms (in absolute frequency)



4.3B: Training of staff and export status according to the category of firms (in % of the total of each category)



The descriptive statistics, presented in Table 4.3, show that heteroscedasticity risks exist with the variables SIZ, CAPI and COST because of the large differences between the minimum and the maximum. These variables have been transformed in logarithms to reduce this risk while performing our regression analyses.

Table 4.3: Descriptive statistics of quantitative variables

Variables	Mean	Median	Mode	Standard deviation	Minimum	Maximum	Number of observations
SIZ	134.524	30	5	530.295	1	8000	420
SKL	68.838	73,529	100	28.551	0	100	361
FIN	70.319	100	100	37.643	0	100	204
CAPI	2,186,184.264	713114.800	0	5,784,514.674	0	68,000,000	217
COST	1,102,032.762	160,000	100,000	9,608,724.396	1,000	170,000,000	342
YEA	20.278	20	20	10.943	1	50	418
EXP	12.258	0	0	25.169	0	100	419
FOG	8.865	0	0	24.394	0	100	421
FS	0.405	0,442	0,442	0.272	0	1	426
FO	16.715	6.808	6.808	20.808	0	66.4946	426

5. Empirical results

Table 4.4 and Table 4.5 present the results of several probit regressions performed to explain product innovation and process innovation, respectively. In columns (1) – (3) in Table 4.4 and Table 4.5, the overall sample of firms in the manufacturing sector is used to perform the analyses. In columns (4) – (5) in Table 4.4 and Table 4.5, analyses are performed on domestic firms or firms with a foreign participation rate below 10% of the total capital. The column (6) in Table 4.4 refers to analyses performed on the basis of foreign-owned firms (with foreign participation above 10%), but this analysis could not be performed in the case of process innovation because of the small size of the final sample used for the estimation. Columns (2) in Table 4.4 and 3.5 present results from the two-step approach; the latter uses the probability of acquisition by a foreign firm as the weight (See appendix 4.4 for the details of the equation). Due to the low significance of results obtained in the analyses of process innovation, we tried to analyze the phenomenon by considering subsets of the sample, and we found that the proposed framework of analysis provides some results only in the case of medium-size enterprises. As such, columns (6) and (7) in Table 4.5 present results on medium-size enterprises in connection with process innovation and differ basically with the usage or lack of usage of the two-step approach. We focus our interpretation of the results on columns (2), (4) and (5) for the results related to product innovation in Table 4.4 and on columns (2), (6) and (7) for the results related to process innovation in Table 4.5. Other results are provided for reference and robustness purposes.

Table 4.4: Probit regressions – Dependent variable: Product Innovation

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Size	-0.0462 (-0.45)	0.2155 (01.29)	-0.0463 (-0.45)	-0.1098 (-0.94)	-0.1097 (-0.93)	0.5577 (1.47)
Years of experience	0.0321** (2.58)	0.0385** (1.96)	0.0321** (2.58)	0.0371** (2.25)	0.0372** (2.28)	0.0002 (0.01)
Research and development	1.2114*** (4.24)	1.1500*** (2.68)	1.2046*** (4.22)	1.1359*** (3.45)	1.1400*** (3.41)	1.8671*** (3.32)
Skilled labor force	-0.0097** (-2.02)	-0.0085 (-1.26)	-0.0097** (-1.99)	-0.0139** (-2.25)	-0.0139** (-2.27)	-0.0055 (-0.50)
Training of labor force	0.4321 (1.47)	0.3519 (0.76)	0.4290 (1.46)	0.4552 (1.32)	0.4600 (1.34)	1.3565** (2.58)
Exports	-0.0089 (-1.30)	-0.0227** (-2.43)	-0.0088 (-1.32)	0.0032 (0.39)	0.0024 (0.28)	-0.0382*** (-3.16)
Financing	0.0026 (0.84)	-0.0073 (-1.39)	0.0027 (0.83)	0.0020 (0.56)	0.0019 (0.53)	0.0135 (1.58)
Foreign ownership		0.0062 (0.72)	-0.0002 (-0.03)			-0.0147 (-0.67)
Foreign presence-BHL				-0.2620 (-0.34)		
Foreign presence-AH					0.0075 (0.80)	
Number of observations	170	97	169	137	137	33
P-value of Chi2 test	0.000	0.000	0.000	0.002	0.001	0.001
Pseudo R2	0.264	0.402	0.265	0.288	0.289	0.401
Proportion of observations correctly classified (%)	84.12	82.47	84.62	82.48	82.48	87.88
Characteristics of the sample	All firms	All firms	All firms	Local firms	Local firms	Foreign firms
Two-step approach	No	Yes	No	No	No	No
Industry dummies	Yes	Yes	Yes	Yes	Yes	No

Notes: *, **, and *** refer to 10%, 5%, and 1% significance levels, respectively. Figures in brackets represent t-statistics. "Foreign presence-BHL" refers to the variable "foreign presence" computed as in Brambilla, Hale, & Long (2009), and "Foreign presence-AH" refers to the one computed as per proposed by Aitken & Harrison (1999). For the classification of "correct" predicted values, the cut-off value has been set to 50%: for a specific firm, if the probability of innovating is above or equal to 50%, it is likely that the firm innovates.

For product innovation, the positive and significant impact of the occurrence of research and development activities as well as the number of years of experience of the manager are confirmed in most columns. These results would suggest that as the number of years

of experience of the manager increases, the probability of having product innovation increases. Furthermore, it could also be inferred that firms with R&D activities have higher probability of innovation. The same could also be the case with process innovation and R&D activities. The results on the impact of the number of years of experience match with the results from Koellinger (2008) and Romero & Martínez-Román (2012) but differ from the results of Avermaete *et al.* (2004), who do not find a significant impact of this variable. The latter case matches mostly with regressions performed to explain process innovation. The results on the importance of R&D activities match with the results of Murovec & Prodan (2009), Raymond & St-Pierre (2010), Pellegrino, Piva, & Vivarelli (2012) and Cuerva, Triguero-Cano, & Córcoles (2013). However, there are two puzzling results that are related to the negative and significant impact of two variables: skilled labor force in both analyses of product and process innovation and exports in the analyses of product innovation.

The negative impact of skilled labor force is contrary to the findings of Cuerva, Triguero-Cano, & Córcoles (2013) and Liu, Hodgkinson, & Chuang (2014) and can be explained by the structure of labor force in the firm and by the definition of the variable used in these analyses. In fact, Avermaete *et al.* (2004) find that a higher proportion of managerial and professional staff can have a negative impact on innovation, whereas a higher proportion of qualified technical staff is positively associated with innovation. The authors suggest that a higher proportion of managerial and professional staff hinders the efficiency of the firm as well as its flexibility and reduces its competitiveness; particularly in the food industry. However, our dataset does not allow us to make this differentiation; the variable "skilled labor force" represents the

proportion of skilled production workers, and innovations emanate from technical staff with a specific expertise, not mainly from production workers.

Table 4.5: Probit regressions – Dependent variable: Process Innovation

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Size	-0.1213 (-1.29)	-0.3501** (-2.09)	-0.1236 (-1.31)	-0.0758 (-0.78)	-0.0759 (-0.78)	-0.4417** (-2.17)	-1.3908*** (-3.48)
Years of experience	0.0059 (0.56)	0.0308* (1.78)	0.0064 (0.60)	0.0135 (1.23)	0.0134 (1.22)	0.0046 (0.24)	0.0391 (1.33)
Research and development	0.5338** (2.09)	0.8070** (1.97)	0.5259** (2.06)	0.6000** (2.00)	0.6000** (2.00)	-0.0537 (-0.10)	1.6422 (1.60)
Skilled labor force	-0.0075** (-2.03)	-0.0144** (-2.35)	-0.0077** (-2.08)	-0.0040 (-0.91)	-0.0041 (-0.93)	-0.0131* (-1.69)	-0.0588 (-2.98)
Training of labor force	0.2678 (1.04)	0.5832 (1.28)	0.2585 (1.00)	0.0941 (0.32)	0.0945 (0.32)	1.3000*** (2.66)	1.7622** (2.09)
Exports	-0.0018 (-0.32)	-0.0106 (-1.20)	-0.0017 (-0.29)	-0.0076 (-1.27)	-0.0076 (-1.27)	-0.0071 (-0.39)	-0.0482** (-2.01)
Financing	0.0021 (0.70)	0.0093* (1.74)	0.0021 (0.70)	0.0042 (1.34)	0.0042 (1.34)	-0.0042 (-0.81)	0.0014 (0.15)
Foreign ownership		-0.0065 (-1.13)	0.0002 (0.05)				
Foreign presence-BHL				0.0009 (0.00)		-0.2356 (-0.36)	-1.3100 (-0.94)
Foreign presence-AH					-0.0001 (0.01)		
Number of observations	177	100	176	143	143	69	42
P-value of Chi2 test	0.2044	0.000	0.250	0.184	0.184	0.037	0.005
Pseudo R2	0.083	0.343	0.083	0.076	0.076	0.174	0.651
Proportion of observations correctly classified (%)	n.a.	82.00	n.a.	n.a.	n.a.	85.51	90.47
Characteristics of the sample	All firms	All firms	All firms	Local firms	Local firms	Medium size firms	Medium size firms
Two-step approach	No	Yes	No	No	No	No	Yes
Industry dummies	Yes	Yes	Yes	No	No	No	No

Notes: *, **, and *** refer to 10%, 5%, and 1% significance levels, respectively. Figures in brackets represent t-statistics. "Foreign presence-BHL" refers to the variable "foreign presence" computed as in Brambilla, Hale, & Long (2009), and "Foreign presence-AH" refers to the one computed as per proposed by Aitken & Harrison (1999).
Equation (6) cannot be estimated because of the small size of the sample of foreign firms which could be used to estimate coefficients. "n.a." refers to "non-applicable" because of the overall significance of the model.

In the analysis of product innovation, the negative impact of "*exports*" on product innovation does not match with results from other studies such as Becker & Dietz (2004) and Sun & Du (2010). This result can be explained by the particularity of the Kenyan data and private sector: only about one-fifth of the firms in the manufacturing sector export and innovate, and many of these firms are concentrated in the food industry. However, detailed empirical analyses show that firms in the food industry have a lower probability of innovating.

Pertaining to the role of FDI in spurring technological transfer, the results from the above analyses show that FDI inflows do not have a significant impact on product and process innovations. In fact, none of the estimated coefficients are significantly different from zero. For robustness purposes, the same type of analysis has been performed by export status – a firm being considered as an exporting firm if the share of exports in total sales is above 10% - and results are generally not different from the ones presented in the previous tables (*see appendices 4.2 and 4.3*). These results are similar to the ones found by Farole & Winkler (2014) in Africa, Waldkirch & Ofosu (2010) in Ghana and Bwalya (2006) in Zambia.

The absence of technological transfer can be explained by the following factors: the pattern and trend of FDI inflows hosted by the country, patent rights, the characteristics of local firms that are present in the economy and the skilled of the labor force employed by local firms (*see the above results on the negative impact of the labor force on innovation*).

Concerning the trend and pattern of FDI inflows, it can be mentioned that the presence of FDI inflows is relatively small in comparison with other countries from the African

region. In fact, according to the statistics released by UNCTAD, during the period from 1980 to 2012, FDI inflows represented on average less than 1% of the GDP and culminated only recently in 2013 at 1.1% of the GDP. Furthermore, the simple average proportion of private foreign ownership is equal to 5.8%, whereas it is equal 13.7% in Sub-Saharan Africa according to the World Bank Enterprise Surveys database. Moreover, FDI inflows seem to be highly concentrated in the food industry because more than one-third of the sampled FIEs belong to this industry; food products normally have specific standards to meet before being allowed to be sold on public markets. These standards could be difficult to attain for a sizeable number of local firms.

Pertaining to the characteristics of local firms, at least two-thirds of the firms in the manufacturing sector are small and medium enterprises, and these firms *(i)* are less likely to recruit staff from multinational companies (mobility of workers) or cannot easily imitate products produced by MNEs (reverse engineering), although these channels are among the most important ones for horizontal spillovers, according to Görg & Greenaway (2004). and *(ii)* small and medium firms are likely to have high operating costs and/or low productivity, which does not allow them to imitate, according to Brambilla, Hale, & Long (2009). In fact, the staff from MNEs generally have higher wages than the wages proposed by domestic firms, and this policy contributes to the reduction of the turnover rate and allows them to recruit the "best" people. Conversely, reverse engineering requires having specific capacities that domestic firms may not always have because they cannot recruit adequate personnel. Concerning the productivity, a comparison of the ratio of cost of production to capital shows that the ratio for SMEs is almost sevenfold of the ratio of cost of production to capital of large firms.

Finally, with reference to the patent rights regulatory framework, two facts can be raised: the usage of strong intellectual property rights by MNEs because their products are registered at the international level and the weakness of the intellectual property rights (IPR) framework of Kenya is among the worst according to the non-governmental organization *"Property Rights Alliance"*.[29] In fact, the intellectual property rights framework can have an impact on innovation, according to the findings of Krammer (2009) and Jiang *et al.* (2011). Although Jiang *et al.* (2011) find that it is possible for MNCs to influence the intellectual property rights framework because of their bargaining power with the government, the actual level of FDI and the number of MNCs in Kenya may not have yet reached the critical level to have an influence on IPR regulations. In addition, Krammer (2009) find that a stronger intellectual property framework can positively contribute to innovativeness. The low protection offered by the Kenyan IPR framework could also lead to the usage of alternative protection strategies such as secrecy and complex design (De Faria & Sofka, 2010). These strategies could increase the difficulties in imitating the products produced by MNEs.

6. Conclusion and summary

The objective of the paper was to analyze the impact of FDI inflows on technological transfer in Kenya. On the basis of firm level data observed in 2012/2013 by the World Bank Enterprise Surveys and by analyzing potential horizontal spillovers, it is concluded that the presence of foreign investments did not spur technological transfer. It is inferred that technological transfer did not occur because foreign investments are

[29] http://internationalpropertyrightsindex.org/countries (accessed on May 28, 2015)

located in industries with high standards, such as food, domestic firms are relatively small and cannot afford recruiting foreign employees or performing reverse engineering activities, and the weaknesses of the intellectual property rights frameworks may not stimulate local innovations. Finally, the actual skills of the labor force (in local firms) may be an impediment to the occurrence of innovation. However, this study presents some limitations because it only uses the most recent survey and not panel data, and the size of the sample is not large. Vertical spillovers and regional effects could also be considered in future studies.

7. Appendices

Appendix 4.1: Definition and computation of variables (Questionnaire of the 2013 Kenya Enterprise Survey)

Product innovation (ID): "During the last three years, has this establishment introduced new or significantly improved products or services?" (Question H.1)

Process innovation (IC): "During the last three years, has this establishment introduced any new or significantly improved methods of manufacturing products or offering services?" (Question H.3)

Firm size (SIZ): Permanent, full-time workers end of last fiscal year (Question L.1)

Years of experience of manager (YEA): "How many years of experience working in this sector does the Top Manager have?" (B.7)

R&D activities (RD): "During the last three years, did this establishment spend on formal research and development activities, either in-house or contracted with other companies? (H.7)"

Skilled labor force (SKL): Proportion of skilled labor production workers in the population of production workers at the end of the last complete fiscal year 100*(L4a/(L4a+L4b)).

Training of labor force (TRL): "In the last complete fiscal year, did this establishment have formal training programs for its permanent, full-time employees?" (L.10)

Exports (EXP): Percentage of direct exports in total sales of the establishment (d3c)

Assets purchased without bank funds (FIN): Estimated proportion of this establishment's total purchase of fixed assets that was not financed through loans from private and state-owned banks or non-bank financial institutions. These sources include internal funds or retained earnings, purchases on credit from suppliers and advances from customers, owners' contribution or issued new equity shares, and other sources such as moneylenders, friends, relatives, bonds, etc. (100 minus k5e minus k5bc)

Share of foreign capital in a firm (FOG): Percentage of the firm which is owned by private foreign individuals, companies or organizations (b2b).

Age of the firm (AGE): Age of the firm as of the year of the survey (b6b).

Capital intensity (CAPI): It is supposed to be equal to the total value of assets divided by the total number of employees. However, the survey does not ask explicitly the capital of the firm. Thus, a *proxy variable* is used on the basis of the assumption that the value of the total assets of the firm should be closed to the ones made-up of machinery,

vehicles, equipment, land and buildings. The following question is asked: "*From this establishment's Balance Sheet for the last complete fiscal year, what was the net book value, that is the value of assets after depreciation?*" and answers are expected under two items: "Machinery, vehicles, and equipment" and "Land and buildings" (Questions N.6; n6a and n6b). The total number of employees refers to the firm size.

Labor cost per employee (COST): Ratio of n2a by SIZ.

Industry dummies (IND): All the sectors listed in question A.4 (a4a), under the sub-section manufacturing and excluding "Recycling."

Total sales (SAL): Last complete fiscal year's total sales (d2)

Appendix 4.2: Kenya – Probit regressions by exporting status - Dependent variable: Product innovation

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Size	-0.1518 (-0.72)	0.0210 (0.16)	0.8086** (2.58)	-0.0510 (-0.28)	0.0472 (0.40)	-0.3971 (-1.38)
Years of experience	-0.0022 (-0.10)	0.0689*** (3.40)	0.0969*** (2.70)	-0.0010 (-0.04)	0.0425** (2.48)	0.0255 (0.86)
Research and development	0.8242* (1.92)	1.9907*** (4.20)	2.3079** (2.55)	0.9153* (1.56)	1.1956*** (2.69)	0.3762 (0.58)
Skilled labor force	0.0064 (1.03)	-0.0133* (-1.90)	0.0042 (0.33)	0.0047 (0.69)	-0.0058 (-0.79)	-0.0003 (-0.03)
Training of labor force	1.2629*** (2.91)	-0.1939 (-0.47)	0.3748 (0.65)	1.2648** (2.08)	-0.0343 (-0.09)	1.6062*** (2.90)
Exports	-0.0045 (-0.41)	0.2001 (1.13)	0.3628 (1.49)	-0.0142 (-0.85)	0.1593 (1.06)	0.0147 (0.97)
Financing	0.0056 (0.88)	0.0041 (0.05)	0.0127 (1.38)	-0.0085 (-1.26)	0.0003 (0.08)	0.0033 (0.39)
Foreign ownership	-0.0047 (-0.77)	0.0004 (0.05)	-0.0066 (-0.53)	0.0080 (1.35)		
Foreign presence-BHL					-0.8028 (-1.46)	-0.9014 (-1.05)
Number of observations	67	105	63	40	93	50
P-value of Chi2 test	0.006	0.013	0.000	0.099	0.031	0.039
Pseudo R2	0.270	0.373	0.559	0.302	0.197	0.313
Proportion of observations correctly classified (%)	89.55	87.62	87.30	n.a.	80.65	88.00
Characteristics of the sample	All exporting firms	All non-exporting firms	All non-exporting firms	All exporting firms	Local non-exporting firms	Local exporting firms
Two-step approach	No	No	Yes	Yes	No	No
Industry dummies	No	Yes	Yes	No	No	No

Notes: *, **, and *** refer to 10%, 5%, and 1% significance levels, respectively. Figures in brackets represent t-statistics. "Foreign presence-BHL" refers to the variable "foreign presence" computed as in Brambilla, Hale, & Long (2009), and "Foreign presence-AH" refers to the one computed as per proposed by Aitken & Harrison (1999). For the classification of "correct" predicted values, the cut-off value has been set to 50%: for a specific firm, if the probability of innovating is above or equal to 50%, it is likely that the firm innovates. "n.a." refers to "non-applicable" because of the overall significance of the model.

Appendix 4.3: Kenya – Probit regressions by exporting status - Dependent variable: Process innovation

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Size	-0.4326*** (-2.60)	-0.0149 (-0.13)	0.1111 (0.42)	-0.6952** (-2.41)	0.0783 (0.67)	-0.5028** (-2.47)
Years of experience	-0.0087 (-0.48)	0.0135 (1.07)	0.0848** (2.07)	0.0127 (0.43)	0.0189 (1.34)	0.0013 (0.07)
Research and development	0.3436 (0.75)	0.6053** (2.01)	1.9642** (2.46)	0.7892 (1.44)	0.7034* (1.91)	0.6172 (1.19)
Skilled labor force	-0.0086 (-1.52)	-0.0045 (-0.85)	-0.0169* (-1.41)	-0.0019 (-0.27)	-0.0009 (-0.16)	-0.0063 (-0.91)
Training of labor force	0.5721 (1.27)	-0.1028 (-0.32)	-0.9293 (-1.07)	1.8218** (2.42)	-0.1614 (-0.45)	0.3508 (0.62)
Exports	3.85e-06 (0.00)	-0.0657 (-0.87)	-0.0242 (-0.14)	-0.0076 (-0.43)	-0.0156 (-0.13)	-0.0034 (-0.31)
Financing	0.0030 (0.52)	0.0016 (0.43)	-0.0041 (-0.29)	-0.0020 (-0.31)	0.0049 (1.17)	0.0040 (0.62)
Foreign ownership	0.0093 (1.33)	-0.0121 (-1.83)	-0.0639*** (-2.97)	0.0029 (0.49)		
Foreign presence-BHL					0.2561 (0.48)	-0.4744 (-0.67)
Number of observations	67	109	58	35	93	50
P-value of Chi2 test	0.039	0.160	0.000	0.007	0.305	0.103
Pseudo R2	0.191	0.081	0.575	0.450	0.084	0.223
Proportion of observations correctly classified (%)	86.57	n.a.	86.21	88.57	n.a.	n.a.
Characteristics of the sample	All exporting firms	All non-exporting firms	All non-exporting firms	All exporting firms	Local non-exporting firms	Local exporting firms
Two-step approach	No	No	Yes	Yes	No	No
Industry dummies	No	No	Yes	No	No	No

Notes: *, **, and *** refer to 10%, 5%, and 1% significance levels, respectively. Figures in brackets represent t-statistics. "Foreign presence-BHL" refers to the variable "foreign presence" computed as in Brambilla, Hale, & Long (2009), and "Foreign presence-AH" refers to the one computed as per proposed by Aitken & Harrison (1999). For the classification of "correct" predicted values, the cut-off value has been set to 50%: for a specific firm, if the probability of innovating is above or equal to 50%, it is likely that the firm innovates. "n.a." refers to "non-applicable" because of the overall significance of the model.

Appendix 4.4: Results of the probit regression used for the selection of MNE

Dependent variable:

$$FDI = \begin{cases} 1 \; if \; foreeign \; ownership \geq 10\% \\ 0 \; if \; foreign \; ownership < 10\% \end{cases}$$

Variables	Coefficients	t-statistics	p-value
SIZ	0.2633	2.82	0.005
COST	-0.0147	-0.32	0.751
CAPI	0.2292	2.50	0.012
EXP	-0.0033	-0.59	0.555

Industry dummy variables are included.

Number of observations = 192

LR chi2 (15) = 27.13

P-value = 0.028

Pseudo R^2 = 0.160

General Conclusion

General Conclusion

This thesis attempts to analyze the impact of foreign direct investment (FDI) inflows on African countries, particularly on their economic growth (expansion), industrialization (level of manufacturing of activities), and technological transfer. For this purpose, the dissertation has been organized into three substantive chapters.

Chapter 1 analyzes the impact of FDI inflows on economic growth and tries to shed some light on the role of absorptive capacities (human) in this process. Among the limited number of published empirical studies, this study differs from the others by focusing on most African countries (50 out of 54 countries) by analyzing them over a long period of time (1980-2009), going beyond the concept of real economic growth rates, understood as the growth rate of gross domestic product in volume, and also analyzing power purchase power parities (PPPs) economic variables to provide an answer to the research question. The empirical results show that FDI inflows indeed had a significant and positive impact on the expansion of African economies during the period of study, but this impact seems to have been stronger during the period from 1995 to 2009 than during the period from 1980 to 1994. Moreover, the impact on African economies was not constrained by the low level of human capital. Thus, the assumption on the importance of human absorptive capacities, suggested and found in some empirical studies, in maximizing the impact of FDI inflows in host countries was not found. I interpret these results as further evidence of the nature of FDI inflows received in Africa: resource-seeking FDI inflows. In fact, resource-seeking FDI would require having access to a very low-skilled labor force, such as in the case of coal, diamonds, and gold mines, or using capital-intensive technologies such as in the case of

hydrocarbon commodities. Moreover, the interdependence between the resource and the non-resource sectors is generally low.

After analyzing the impact of FDI inflows on the economic expansion of African countries, **Chapter 2** analyzes their role in the industrialization-deindustrialization of African countries. This study is among the pioneering studies that focus on Africa; [30] it analyzes 49 African countries during an important timespan (30 years), and it uses output data from national accounts as dependent variables instead of using export data as has been done in some studies. The econometric analyses show that FDI inflows did not have a significant impact on industrialization, measured as the value added of the manufacturing sector in terms of percentage of the GDP: this result reinforces the results on the impact of FDI inflows on economic growth and the absence of a constrained impact related to low human capacities. These empirical analyses also show that the governments' interventions did not contribute significantly and positively to industrialization. It is thus inferred that two reasons for the failure of FDI to contribute to industrialization could be government's ineffective interventions and governments' failure to establish the enabling environment to attract FDI inflows in the manufacturing sector. For instance, some studies suggest that some African countries implemented unfriendly measures for industrialization, such as monopoly restrictions including exclusive exploration rights, sole supplier contracts, and domestic-market exclusivity. These measures could not help strengthen the backward, forward or horizontal linkages that could have been established between MNCs and local enterprises.

[30] I did not find a study addressing the same topic in the African region, but it may be possible that such studies exist. However, they have not been published in reference databases of peer-reviewed journals. They may have been published in other formats.

Because it seems that the expect positive spillover effects from FDI inflows did not appear in African countries in general, **Chapter 3** attempts to analyze technological transfer by performing a country-case analysis. **Chapter 3** analyzes international technological transfer in Kenya on the basis of the latter's 2013 Enterprise Surveys dataset. Kenya was chosen because its exports are relatively diversified and present in neighboring countries, its manufacturing sector accounts for more than 10% of the GDP and it is not a resource-based economy. This paper differs from others because it analyzes technological transfer on the basis of a dependent variable that is not derived from an econometric method but rather on the basis of a variable obtained from a direct answer to a question related to the occurrence of innovation during a reference period. Moreover, this study contributes to the literature by only analyzing the occurrence of horizontal spillovers, and it uses a two-step approach that considers the issue of selection of firms by multinational enterprises. The econometric analyses of the role of FDI in spurring technological transfer show that FDI inflows are not having a significant impact on product and process innovations in this country and thus do not contribute enough to technological transfers (horizontal spillover effects).

Several policy implications can be drawn from the above mentioned results. The results from **Chapter 1** and **Chapter 2** reinforce the following analyses or assumptions:

- In a context of a lack of accurate sectoral FDI inflows statistics, African countries received a high amount of resource-seeking FDI inflows; and
- FDI inflows received in natural resources sectors are disconnected from the rest of the economy and cannot easily contribute to the industrialization of a country unless appropriate policies are taken by national authorities to use these resources as a plinth for diversification.

To the question on what should be done on the basis of these results, I can refer to the implementation of policies aiming at attracting the "right" category of FDI inflows or foreign investors. The "right" category of FDI inflows can include market-seeking FDI and FDI hosted in connection with the participation of the country in the global value chain (GVC). These policies include, without being exhaustive, policies that contribute to the availability of a skilled labor force, the improvement of business climate and institutional quality (control corruption, government effectiveness and rule of law), and the construction of adequate infrastructures.

To finance these programs, improving governance would be an important element because it could allow enhancing the management of public finance, closing loopholes emerging from the misapplication of laws, and attracting institutional investors such as development banks.

The results from **Chapter 3** show that even in a non-resource dependent country such as Kenya, receiving FDI inflows in a non-resource sector does not mean that horizontal spillovers would automatically occur. The analyses performed in this chapter confirm that training the labor force could contribute to innovation. Because the impact of skilled labor force on the occurrence of innovation is negative, it is inferred that the existing skills or the breakdown of this labor force, at the firm level, do not allow it to contribute effectively to innovation but rather are an impediment to innovation or change.

To overcome these issues, medium-term and long-term actions can be carried out. For instance, medium-term actions may include the training of the labor force because it exhibits a positive impact on innovation. The government may support training programs offered by firms or may initiate trainings in specific sectors of interest. Long-

term actions may include reforms of training programs at different levels of education and exchange programs with international universities. The objective of these reforms would be to develop specific cognitive capabilities that can allow students to be trained to "*think out of the box*". However, the conclusions of this dissertation are based on analyses that present some caveats, but they constitute an interesting signal and open a path for future research in similar countries.

For instance, it was not possible to have access to time-varying data on institutional quality that are produced by the International Country Risk Guide (ICRG). These indicators could have been included in the analysis of economic growth and industrialization (**Chapter 1** and **Chapter 2**). Vertical spillover effects were not analyzed in **Chapter 3**, and the geographical dimension of FDI-related spillover effects could be interesting to analyze. Future research will attempt to take into account these issues.

It would be interesting to analyze those issues because the government is responsible of the improvement of the institutional quality and the impact of this dimension on the attractiveness of African countries has been ambiguous while it is understood that low institutional quality hinders the sustained economic expansion of a country. Thus, integrating all these elements in the same system could provide elements to support the policy formulation. Furthermore, the regional dimension of FDI-related spillovers and vertical spillovers would be interesting to analyze because some African governments plan to establish special economic zones with a significant participation of foreign investors. As such, the regional dimension of spillovers and the integration of local firms as upstream or downstream operators could play an important role as means of technological transfer.

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